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W. R. MACDONELL

Born October 16, 1852. Died May 15, 1916.

FOR the third time the hand of death has fallen heavily on this Journal. Dr W. R. Macdonell died on May 15 at the relatively early age of 63. On his retirement from business in 1899, at the suggestion of W. H. Macaulay he joined the Biometric Laboratory to do research work, and his patient labour, his wise counsel and lovable disposition soon made him an essential part of the place. It would be difficult to appraise adequately the help he gave to the Biometric School in its early days. It was not only in material and apparatus, it was not only in resourceful suggestion to his fellow-workers, but it was especially in the general sense of courage and in the spirit of readiness to undertake the tedious because it meant profit to science in the future, which he diffused around him that his help was so invaluable. And there was need of the heartening which Macdonell gave! The first greeting that Fawcett's paper on the Naqada crania, involving years of work, received from anthropologist and anatomist was anything but favourable, but Macdonell persisted on the lines thus laid down in his great memoirs on the 17th century English crania, and it would have gladdened him to have seen Fawcett's memoir now described by a distinguished anthropologist as Fawcett's "classical memoir," and the anatomical author of the most recent British cranial research stating that he "cannot do better than follow the scheme adopted by Fawcett in her study of the Naqada crania and also by Macdonell in his study of the Whitechapel English crania and other series of English skulls." It takes a long while to reform any branch of science, but when the history of craniometry comes to be written, those early workers in the Biometric Laboratory will be remembered, and not the least Macdonell, who gave heart to them all.

When *Biometrika* was founded Macdonell joined the little group of men who provided the guarantee fund—there is small harm now in mentioning their names: Francis Galton, W. F. R. Weldon, W. R. Macdonell, Lord Parker of Waddington, and the present Editor—and the aid then provided carried this Journal through the troublous days of infancy to the completely self-supporting stage which preceded the war. It is a sad element in the fate of this Journal that it has to meet a new crisis in its existence with many new friends it is true, but without the majority of the old supporters. From the first issue until this very year, Macdonell acted as assistant editor of *Biometrika*, and his name appeared on the title page as such for several years after the death of Weldon. Our readers were, however, very little conscious of all the labour Macdonell put into proof-reading and many

a contributor has profited in a way he little realised by Macdonell's assiduity and not infrequently by his suggestions. Scotland has preserved its knowledge and appreciation of grammar long after grammar has been discarded in England, and few abler proof-readers can be found than a Scotsman trained in Oxford, especially if he has graduated in science, and tempered his science with modern European literature as a hobby. The width of Macdonell's studies and of his interests was effectively demonstrated by his memoir "On the Expectation of Life in Ancient Rome and in the Provinces of Hispania and Lusitania and Africa." Few men could have been found to combine the necessary biometric with the still more needful literary training requisite for a study of this character, and fewer still would have concluded it with such words of modesty as Macdonell did. With his death biometry loses a sturdy champion, our subscribers and contributors more than they yet realise, and some of us a close and most trustworthy friend. Not least will this be recognised by the little band of pupils he formed around him during his occupancy of the lectureship on biometry in the University of Aberdeen. He acted straightly and he advised wisely both in his mercantile and in his scientific career. He had the reticence which flows from strength, and the persistency and courage of the strong who are reticent. Life seemed a spacious thing in his handling. What more could we have desired for him?

We owe to the kindness of Professor W. Paton Ker the following brief notes on Macdonell which, emphasising the width of his interests and his genial personality, will enable those of our readers who only know him from his memoirs in *Biometrika* to understand better another of the early members of the Biometric School.

I first met Macdonell in my freshman's term at Balliol: I succeeded him in rooms possibly the worst in College, and he came in a few days later to ask if I had seen his copy of Victor Hugo's poems lying about. This I had already found and now restored to him; it provided something to talk about afterwards. He was a Mathematical Scholar of Balliol and did not neglect his subject, but he always seemed more interested in other things, especially Greek. He had been at Aberdeen along with R. A. Neil of Pembroke, Cambridge, always one of his greatest friends; at Balliol he found another Greek scholar, William Gunion Rutherford. Rutherford and he used to read Greek together for a time. Then Macdonell left Oxford to go into business, and for a year or two I saw nothing of him. But I found him in London when I went there in 1879 after taking my degree; Rutherford was there also, a master at St Paul's School, and we made it a regular thing to meet on Saturday evenings, the three of us, at Rutherford's rooms in Mitre Court. It was a good time while it lasted, but soon we went different ways —Macdonell to India—and I lost sight of him and did not hear much, for several years. Soon after he got to Bombay he wrote to me, asking for the *Journal of Philology* to be sent to him; he was keeping up his Greek and Latin; he was also amused at the manners of scholars in disputation. At Bombay he was once asked by the Danish merchants there to choose for himself a present which they wished to give him in acknowledgement of services rendered by him in connexion

with their business. He chose, as the best thing obtainable from Copenhagen, Madvig's edition of Cicero *De Finibus*, and thought that they were pleased with his choice.

Macdonell was chairman of the Chamber of Commerce in Bombay, and additional member of Council there, 1893–1895. Then he came home, and for some time worked in the London office of his firm. He retired from business in 1899. He had carried out his plans, and earned his leisure. Probably few men are to be trusted with leisure at the age of 47, but Macdonell made the most of his life. He never lost interest in any study that once had engaged his attention, though he had so many interests—in books, pictures, music and travelling—that naturally he could not always attend to everything. He never forgot a friend. He had been six years married when he came home from India, and the friend that was made welcome by his wife, and his children, as well as himself in his house at Enfield has much to thank him for. He made new friends as he went on, through common interests for the most part, and particularly through the investigations in which he took part along with Weldon and Pearson. He felt very deeply the loss of friends; he could scarcely bear to speak of the death of Neil of Pembroke.

He inherited his love of books; one of his early recollections was the farm-house in the Highlands where it was the custom to read aloud in the evenings, usually from some of the English classics but sometimes *Don Quixote* to the farm-servants; light being provided for the reader from a stock of pine splinters, lighted in succession one from another: one of the party was employed in cutting these brands, and a boy held up the light over the book, and renewed it from the supply that was passed to him. Macdonell's people were Catholics, and his study of the humanities may have owed something to the traditions of the Church. Among his friends was Monsignor Fraser, Rector of the Scots College in Rome. I remember Macdonell bringing back from a visit to Rome a story of a pibroch heard at night there, and how the music was traced to the roof of the College—a story that would have delighted Sir Walter Scott.

No weakness of the human race gave Macdonell more amusement than the vanity of biographers, and I can almost see him looking over these notes of mine, and making disrespectful remarks about them. But I am glad to have been allowed to write them, such as they are.

W. P. Ker.

University College, London.
3 *July* 1916.

FURTHER SUPPLEMENTARY TABLES FOR DETERMINING HIGH CORRELATIONS FROM TETRACHORIC GROUPINGS.

By ALICE LEE, D.Sc.

The difficulty of determining correlations between ·80 and 1·00 by the tetrachoric method, owing to the slow convergency of the terms of the fundamental equation for 'tetrachoric r' has long been recognised. In 1912 Everitt* published "Supplementary Tables for Determining High Correlations from Tetrachoric Groupings." These tables much simplified the work within the field in which it is really possible to determine accurately a high correlation—beyond certain values of 'h and k' such determination is impossible owing to the influence of random sampling on a quadrant category which in most practical cases will only contain an isolated unit or two. Everitt's tables covered the values of r from + ·80 to + 1·00 for values of the dichotomic planes given by h and k varying from + ·0 to + 2·6. They admitted at once of our dealing with those cases of negative values of r, for which *either* h or k was negative, but not with cases in which r was negative and both h and k remained of the same sign. The present tables provide for this omitted portion of the possible field and thus complete Everitt's work.

I have followed his method of quadrature in evaluating my integrals. But I have preserved more decimal places than he has done, partly because my significant figures are thrown into higher decimal places than his by the nature of the case, and partly because recent experience in other fields has shown workers in the Biometric Laboratory, that tables are often of service for purposes other than those for which they were originally calculated, and that it is worth while preserving every reliable figure. I think my results are always correct to six figures and generally to the actual number tabulated. While many of the entries would only be of service in the case of total populations approaching the magnitude of census populations, their indication of the high decimal place in which the first significant figure can occur in the 'd' quadrant, will help to dispel the illusion that absence of frequency in a quadrant is necessarily indicative of absolute association, when the table is based on a limited sample. A further reason for the number of figures I have preserved may be found in what I believe to be one of the principal uses of tables of this type. They are not only valuable for the calculation of the correlation in the case of given data, but also in many theoretical investigations where the correlation is supposed known *a priori* and we require

* *Biometrika*, Vol. VIII. p. 385.

to ascertain how many individuals may be expected to possess a combination of characters each of which exceeds a given value. I have adopted throughout Pearson's original notation in his memoir on the fourfold table*, i.e. d is the frequency of the quadrant diagonally opposed to that in which the mean falls, i.e.:

$$\frac{d}{N} = \frac{1}{2\pi\sqrt{1-r^2}} \int_h^\infty \int_k^\infty e^{-\frac{1}{2}\frac{1}{1-r^2}(x^2-2rxy+y^2)}\, dx\, dy,$$

where in our case r is given values from $-\cdot 8$ to $-1\cdot 0$. This is the integral I have tabled. For the case of $r = -1\cdot 0$, d/N will be zero for all values of h and k, so that it is not needful to provide a table for $r = -1\cdot 0$ and interpolation between $-\cdot 95$ and $-1\cdot 0$ must be between the values given in the table for $-\cdot 95$ and zero values.

Illustration I. An appreciation of sex was made by two different observers on 216 femora. It is required to find a measure of the association in judgment between the two observers.

In appreciating sex by the examination of a bone the observers opinion varies from practical certainty of maleness through every shade of doubt to practical certainty of femaleness. The strength of the judgment is therefore a continuous character, although the actual sex forms a rigid categorical differentiation. It is with the judgment, and not with the actual sex that we are here concerned, and we have simplified those judgments down to unique categories ♂ and ♀ classifying under each all queried values.

The table is:

First observer

Second observer	♂	♀	Totals
♂	98	16	114
♀	6	96	102
Totals	104	112	216

Mean (between ♂ and ♀ rows)

Mean (between ♂ and ♀ columns)

Rearranging in standard form:

16	98	114
96	6	102
112	104	216

we see that h and k will now both be positive and r will be negative.

* *Phil. Trans.* Vol. 195, A, p. 1.

We have $d/N = 6/216 = \cdot02778$,

$$\tfrac{102}{216} = \tfrac{1}{2}(1 - a_1) = \cdot47222, \qquad \tfrac{104}{216} = \tfrac{1}{2}(1 - a_2) = \cdot48148,$$

or $$h = \cdot06969, \qquad k = \cdot04644.$$

From the Tables for $r = -\cdot95$

$$\left.\begin{matrix} h = 0 \\ k = 0 \end{matrix}\right\} \frac{d}{N} = \cdot050{,}542 \qquad \left.\begin{matrix} h = \cdot1 \\ k = 0 \end{matrix}\right\} \frac{d}{N} = \cdot033{,}024$$

hence $\left.\begin{matrix} h = \cdot06969 \\ k = 0 \end{matrix}\right\} \frac{d}{N} = \cdot038{,}334,$

$$\left.\begin{matrix} h = 0 \\ k = \cdot1 \end{matrix}\right\} \frac{d}{N} = \cdot033{,}024 \qquad \left.\begin{matrix} h = \cdot1 \\ k = \cdot1 \end{matrix}\right\} \frac{d}{N} = \cdot020{,}318$$

hence $\left.\begin{matrix} h = \cdot06969 \\ k = \cdot1 \end{matrix}\right\} \frac{d}{N} = \cdot024{,}169.$

From the last column on right we deduce:

$$h = \cdot06969, \quad k = \cdot04644, \quad \frac{d}{N} = \cdot031{,}756.$$

For the given values of h and k we have accordingly:

$$r = 1\cdot00, \qquad r = -\cdot95,$$
$$d/N = 0, \qquad d/N = \cdot031{,}756.$$

Thus for $d/N = \cdot02778$, we have $r = -\cdot9562$.

Accordingly for the table returned to its original form, we conclude that the association between judgments of sex made by two independent and competent observers from the femur is measured by a tetrachoric correlation of $+\cdot956$.

Illustration II. The following data are for the French long bones in the male, maximum lengths:

Femur: Mean = 452·28 mm. *Humerus*: Mean = 330·10 mm.

Standard deviation = 23·72 mm. Standard deviation = 15·38 mm.

Correlation of femur and humerus = ·8421.

(*a*) Find the percentage of cases in which a humerus of under 300 mm will be combined in the same individual with a femur of over 480 mm.

Here $h = 27\cdot72/23\cdot72 = 1\cdot16863$; $k = -30\cdot10/15\cdot38 = -1\cdot95709$.

Since h is positive, k negative and r positive, we must replace our system by

$$h = 1\cdot16863, \quad k = 1\cdot95709, \quad \text{and} \quad r = -\cdot8421.$$

Our tables for $r = -\cdot80$ and $-\cdot85$ show that for the given values of h and k the required frequency would probably be less than 1 in 50,000,000. We may conclude therefore that no such individuals would occur in the total French male population. This is a result whose order would hardly be appreciated without an examination of the present tables.

(*b*) Find the percentage of cases in which a humerus of under 320 mm. will be associated with a femur of over 460 mm.

Here $h = 7{\cdot}72/23{\cdot}72 = {\cdot}32546$; $k = -\,10{\cdot}10/15{\cdot}38 = -\,{\cdot}65670$.
Accordingly our system is

$$h = {\cdot}32546, \qquad k = {\cdot}65670, \qquad r = -\,{\cdot}8421.$$

Our Tables give for $r = -\,{\cdot}80$

$$\left.\begin{matrix} h = {\cdot}3 \\ k = {\cdot}6 \end{matrix}\right\} d/N = {\cdot}009{,}0146; \qquad \left.\begin{matrix} h = {\cdot}3 \\ k = {\cdot}7 \end{matrix}\right\} d/N = {\cdot}006{,}2334.$$

Thus, for $h = {\cdot}3$, $k = {\cdot}65670$, $d/N = {\cdot}007{,}4377$.

Again $$\left.\begin{matrix} h = {\cdot}4 \\ k = {\cdot}6 \end{matrix}\right\} d/N = {\cdot}006{,}3352; \qquad \left.\begin{matrix} h = {\cdot}4 \\ k = {\cdot}7 \end{matrix}\right\} d/N = {\cdot}004{,}3066.$$

Thus for $h = {\cdot}4$, $k = {\cdot}65670$, $d/N = {\cdot}005{,}1850$. Accordingly for

$$h = {\cdot}32546, \qquad k = {\cdot}65670,$$

we find $$d/N = {\cdot}006{,}8642.$$

We must now repeat this work for $r = -\,{\cdot}85$.

$$\left.\begin{matrix} h = {\cdot}3 \\ k = {\cdot}6 \end{matrix}\right\} d/N = {\cdot}004{,}6616; \qquad \left.\begin{matrix} h = {\cdot}3 \\ k = {\cdot}7 \end{matrix}\right\} d/N = {\cdot}002{,}9477.$$

Thus for $h = {\cdot}3$, $k = {\cdot}65670$, $d/N = {\cdot}003{,}6898$,

$$\left.\begin{matrix} h = {\cdot}4 \\ k = {\cdot}6 \end{matrix}\right\} d/N = {\cdot}002{,}9950; \qquad \left.\begin{matrix} h = {\cdot}4 \\ k = {\cdot}7 \end{matrix}\right\} d/N = {\cdot}001{,}8483.$$

Thus for $h = {\cdot}4$, $k = {\cdot}65670$, $d/N = {\cdot}002{,}3448$. Accordingly for

$$h = {\cdot}32546, \qquad k = {\cdot}65670,$$

we find $$d/N = {\cdot}003{,}3474.$$

We have accordingly for the given values of h and k:

$$r = -\,{\cdot}80, \qquad r = -\,{\cdot}85,$$
$$d/N = {\cdot}006{,}8642, \qquad d/N = {\cdot}003{,}3474,$$

or, for $$r = -\,{\cdot}8421, \qquad d/N = {\cdot}003{,}9006.$$

Accordingly the occurrence of individuals with femur and humerus within the limits given is about 0·4 per cent. of the male French population.

Many other illustrations will occur to the biometric reader of cases wherein these additional tables are likely to be of service. I have to record my very hearty thanks to Dr W. F. Sheppard for the loan of his manuscript tables of the probability integral which enabled me to work to a larger number of figures than his published tables, which go to fewer figures, would have permitted.

d/N for $r = -\cdot 80$.

	$h=0$	$h=\cdot1$	$h=\cdot2$	$h=\cdot3$	$h=\cdot4$	$h=\cdot5$	$h=\cdot6$	$h=\cdot7$	$h=\cdot8$
$k=$ 0	·1024,160	·0835,592	·0669,639	·0526,767	·0406,497	·0307,541	·0227,991	·0165,531	·0117,648
·1	·0835,592	·0673,159	·0532,349	·0413,006	·0314,152	·0234,157	·0170,936	·0122,156	·0085,420
·2	·0669,639	·0532,349	·0415,199	·0317,511	·0237,937	·0174,638	·0125,482	·0088,225	·0060,673
·3	·0526,767	·0413,006	·0317,511	·0239,210	·0176,518	·0127,520	·0090,146	·0062,334	·0042,143
·4	·0406,497	·0314,152	·0237,937	·0176,518	·0128,207	·0091,123	·0063,352	·0043,066	·0028,615
·5	·0307,541	·0234,157	·0174,638	·0127,520	·0091,123	·0063,694	·0043,534	·0029,084	·0018,986
·6	·0227,991	·0170,936	·0125,482	·0090,146	·0063,352	·0043,534	·0029,242	·0019,193	·0012,306
·7	·0165,531	·0122,156	·0088,225	·0062,334	·0043,066	·0029,084	·0019,193	·0012,373	·0007,790
·8	·0117,648	·0085,420	·0060,673	·0042,143	·0028,615	·0018,986	·0012,306	·0007,790	·0004,814
·9	·0081,817	·0058,423	·0040,797	·0027,849	·0018,578	·0012,107	·0007,705	·0004,788	·0002,904
1·0	·0055,652	·0039,068	·0026,812	·0017,982	·0011,782	·0007,539	·0004,710	·0002,873	·0001,710
1·1	·0037,010	·0025,535	·0017,217	·0011,342	·0007,297	·0004,583	·0002,810	·0001,682	·0000,982
1·2	·0024,056	·0016,307	·0010,799	·0006,985	·0004,412	·0002,720	·0001,637	·0000,961	·0000,550
1·3	·0015,278	·0010,172	·0006,615	·0004,200	·0002,604	·0001,575	·0000,930	·0000,535	·0000,301
1·4	·0009,477	·0006,196	·0003,956	·0002,465	·0001,499	·0000,890	·0000,515	·0000,291	·0000,160
1·5	·0005,741	·0003,685	·0002,309	·0001,412	·0000,842	·0000,490	·0000,278	·0000,154	·0000,083
1·6	·0003,395	·0002,139	·0001,315	·0000,789	·0000,462	·0000,264	·0000,147	·0000,080	·0000,042
1·7	·0001,960	·0001,211	·0000,731	·0000,430	·0000,247	·0000,138	·0000,075	·0000,040	·0000,021
1·8	·0001,104	·0000,669	·0000,396	·0000,229	·0000,129	·0000,071	·0000,038	·0000,020	·0000,010
1·9	·0000,606	·0000,361	·0000,209	·0000,118	·0000,065	·0000,035	·0000,018	·0000,009	·0000,005
2·0	·0000,3252	·0000,1897	·0000,1079	·0000,0599	·0000,0324	·0000,0171	·0000,0088	·0000,0044	·0000,0021
2·1	·0000,1700	·0000,0972	·0000,0542	·0000,0295	·0000,0156	·0000,0081	·0000,0041	·0000,0020	·0000,0010
2·2	·0000,0867	·0000,0486	·0000,0266	·0000,0142	·0000,0074	·0000,0037	·0000,0018	·0000,0009	·0000,0004
2·3	·0000,0431	·0000,0237	·0000,0127	·0000,0066	·0000,0034	·0000,0017	·0000,0008	·0000,0004	·0000,0002
2·4	·0000,0209	·0000,0112	·0000,0059	·0000,0030	·0000,0015	·0000,0007	·0000,0003	·0000,0002	·0000,0001
2·5	·0000,0099	·0000,0052	·0000,0027	·0000,0013	·0000,0007	·0000,0003	·0000,0001	·0000,0001	·0000,0000
2·6	·0000,0045	·0000,0023	·0000,0012	·0000,0006	·0000,0003	·0000,0001	·0000,0001	·0000,0000	

	$h=\cdot9$	$h=1\cdot0$	$h=1\cdot1$	$h=1\cdot2$	$h=1\cdot3$	$h=1\cdot4$	$h=1\cdot5$	$h=1\cdot6$	$h=1\cdot7$
$k=$ 0	·0081,817	·0055,652	·0037,010	·0024,056	·0015,278	·0009,477	·0005,741	·0003,395	·0001,960
·1	·0058,423	·0039,068	·0025,535	·0016,307	·0010,172	·0006,196	·0003,685	·0002,139	·0001,211
·2	·0040,797	·0026,812	·0017,217	·0010,799	·0006,615	·0003,956	·0002,309	·0001,315	·0000,731
·3	·0027,849	·0017,982	·0011,342	·0006,985	·0004,200	·0002,465	·0001,412	·0000,789	·0000,430
·4	·0018,578	·0011,782	·0007,297	·0004,412	·0002,604	·0001,499	·0000,842	·0000,462	·0000,247
·5	·0012,107	·0007,539	·0004,583	·0002,720	·0001,575	·0000,890	·0000,490	·0000,264	·0000,138
·6	·0007,705	·0004,710	·0002,810	·0001,637	·0000,930	·0000,515	·0000,278	·0000,147	·0000,075
·7	·0004,788	·0002,873	·0001,682	·0000,961	·0000,535	·0000,291	·0000,154	·0000,080	·0000,040
·8	·0002,904	·0001,710	·0000,982	·0000,550	·0000,301	·0000,160	·0000,083	·0000,042	·0000,021
·9	·0001,719	·0000,993	·0000,559	·0000,307	·0000,165	·0000,086	·0000,044	·0000,022	·0000,011
1·0	·0000,993	·0000,562	·0000,311	·0000,167	·0000,088	·0000,045	·0000,023	·0000,011	·0000,005
1·1	·0000,559	·0000,311	·0000,168	·0000,089	·0000,046	·0000,023	·0000,011	·0000,005	·0000,002
1·2	·0000,307	·0000,167	·0000,089	·0000,046	·0000,023	·0000,011	·0000,005	·0000,003	·0000,001
1·3	·0000,165	·0000,088	·0000,046	·0000,023	·0000,012	·0000,006	·0000,003	·0000,001	·0000,0005
1·4	·0000,086	·0000,045	·0000,023	·0000,011	·0000,006	·0000,003	·0000,001	·0000,0005	·0000,0002
1·5	·0000,044	·0000,023	·0000,011	·0000,005	·0000,003	·0000,001	·0000,0005	·0000,0002	·0000,0001
1·6	·0000,022	·0000,011	·0000,005	·0000,003	·0000,001	·0000,0005	·0000,0002	·0000,0001	·0000,0000
1·7	·0000,011	·0000,005	·0000,002	·0000,001	·0000,0005	·0000,0002	·0000,0001	·0000,0000	
1·8	·0000,005	·0000,002	·0000,001	·0000,0005	·0000,0002	·0000,0001	·0000,0000		
1·9	·0000,002	·0000,001	·0000,0005	·0000,0002	·0000,0001	·0000,0000			
2·0	·0000,0010	·0000,0005	·0000,0002	·0000,0001	·0000,0000				
2·1	·0000,0004	·0000,0002	·0000,0001	·0000,0000					
2·2	·0000,0002	·0000,0001	·0000,0000						
2·3	·0000,0001	·0000,0000							
2·4	·0000,0000								

d/N for r = − ·80.

	h=1·8	h=1·9	h=2·0	h=2·1	h=2·2	h=2·3	h=2·4	h=2·5	h=2·6
k= 0	·0001,104	·0000,606	·0000,3252	·0000,1700	·0000,0867	·0000,0431	·0000,0209	·0000,0099	·0000,0045
·1	·0000,669	·0000,361	·0000,1897	·0000,0972	·0000,0486	·0000,0237	·0000,0112	·0000,0052	·0000,0023
·2	·0000,396	·0000,209	·0000,1079	·0000,0542	·0000,0266	·0000,0127	·0000,0059	·0000,0027	·0000,0012
·3	·0000,229	·0000,118	·0000,0599	·0000,0295	·0000,0142	·0000,0066	·0000,0030	·0000,0013	·0000,0006
·4	·0000,129	·0000,065	·0000,0324	·0000,0156	·0000,0074	·0000,0034	·0000,0015	·0000,0007	·0000,0003
·5	·0000,071	·0000,035	·0000,0171	·0000,0081	·0000,0037	·0000,0017	·0000,0007	·0000,0003	·0000,0001
·6	·0000,038	·0000,018	·0000,0088	·0000,0041	·0000,0018	·0000,0008	·0000,0003	·0000,0001	·0000,0001
·7	·0000,020	·0000,009	·0000,0044	·0000,0020	·0000,0009	·0000,0004	·0000,0002	·0000,0001	·0000,0000
·8	·0000,010	·0000,005	·0000,0021	·0000,0010	·0000,0004	·0000,0002	·0000,0001	·0000,0000	
·9	·0000,005	·0000,002	·0000,0010	·0000,0004	·0000,0002	·0000,0001	·0000,0000		
1·0	·0000,002	·0000,001	·0000,0005	·0000,0002	·0000,0001	·0000,0000			
1·1	·0000,001	·0000,0005	·0000,0002	·0000,0001	·0000,0000				
1·2	·0000,0005	·0000,0002	·0000,0001	·0000,0000					
1·3	·0000,0002	·0000,0001	·0000,0000						
1·4	·0000,0001	·0000,0000							
1·5	·0000,0000								

d/N for r = − ·85.

	h=0	h=·1	h=·2	h=·3	h=·4	h=·5	h=·6	h=·7	h=·8
k= 0	·0883,010	·0696,651	·0537,127	·0404,314	·0296,851	·0212,402	·0147,991	·0100,334	·0066,146
·1	·0696,651	·0539,919	·0408,547	·0301,542	·0216,905	·0151,935	·0103,559	·0068,639	·0044,211
·2	·0537,127	·0408,547	·0303,123	·0219,192	·0154,352	·0105,767	·0070,478	·0045,639	·0028,705
·3	·0404,314	·0301,542	·0219,192	·0155,166	·0106,889	·0071,604	·0046,616	·0029,477	·0018,094
·4	·0296,851	·0216,905	·0154,352	·0106,889	·0071,984	·0047,113	·0029,950	·0018,483	·0011,068
·5	·0212,402	·0151,935	·0105,767	·0071,604	·0047,113	·0030,109	·0018,680	·0011,246	·0006,566
·6	·0147,991	·0103,559	·0070,478	·0046,616	·0029,950	·0018,680	·0011,306	·0006,637	·0003,777
·7	·0100,334	·0068,639	·0045,639	·0029,477	·0018,483	·0011,246	·0006,637	·0003,797	·0002,106
·8	·0066,146	·0044,211	·0028,705	·0018,094	·0011,068	·0006,566	·0003,777	·0002,106	·0001,137
·9	·0042,377	·0027,658	·0017,526	·0010,778	·0006,428	·0003,717	·0002,083	·0001,131	·0000,595
1·0	·0026,368	·0016,797	·0010,383	·0006,226	·0003,620	·0002,039	·0001,113	·0000,589	·0000,301
1·1	·0015,927	·0009,897	·0005,966	·0003,487	·0001,975	·0001,084	·0000,576	·0000,297	·0000,148
1·2	·0009,335	·0005,656	·0003,323	·0001,893	·0001,044	·0000,558	·0000,289	·0000,145	·0000,070
1·3	·0005,306	·0003,134	·0001,794	·0000,995	·0000,535	·0000,278	·0000,140	·0000,068	·0000,032
1·4	·0002,924	·0001,682	·0000,938	·0000,507	·0000,265	·0000,134	·0000,066	·0000,031	·0000,014
1·5	·0001,561	·0000,875	·0000,475	·0000,250	·0000,127	·0000,063	·0000,030	·0000,014	·0000,006
1·6	·0000,808	·0000,441	·0000,233	·0000,119	·0000,059	0000,028	·0000,013	·0000,006	·0000,003
1·7	·0000,405	·0000,215	·0000,111	·0000,055	·0000,027	·0000,012	·0000,006	·0000,002	·0000,001
1·8	·0000,196	·0000,102	·0000,051	·0000,025	·0000,012	·0000,005	·0000,002	·0000,001	·0000,0004
1·9	·0000,092	·0000,046	·0000,023	·0000,011	·0000,005	·0000,002	·0000,001	·0000,0004	·0000,0001
2·0	·0000,0419	·0000,0205	·0000,0097	·0000,0045	·0000,0020	·0000,0009	·0000,0004	·0000,0001	·0000,0001
2·1	·0000,0184	·0000,0088	·0000,0040	·0000,0018	·0000,0008	·0000,0003	·0000,0001	·0000,0000	·0000,0000
2·2	·0000,0079	·0000,0036	·0000,0017	·0000,0007	·0000,0003	·0000,0001	·0000,0000		
2·3	·0000,0032	·0000,0015	·0000,0006	·0000,0003	·0000,0001	·0000,0000			
2·4	·0000,0013	·0000,0006	·0000,0002	·0000,0001	·0000,0000				
2·5	·0000,0005	·0000,0002	·0000,0001	·0000,0000					
2·6	·0000,0002	·0000,0001	·0000,0000						

d/N for r = − ·85.

	h=·9	h=1·0	h=1·1	h=1·2	h=1·3	h=1·4	h=1·5	h=1·6	h=1·7
k= 0	·0042,377	·0026,368	·0015,927	·0009,335	·0005,306	·0002,924	·0001,561	·0000,808	·0000,405
·1	·0027,658	·0016,797	·0009,897	·0005,656	·0003,134	·0001,682	·0000,875	·0000,441	·0000,215
·2	·0017,526	·0010,383	·0005,966	·0003,323	·0001,794	·0000,938	·0000,475	·0000,233	·0000,111
·3	·0010,778	·0006,226	·0003,487	·0001,893	·0000,995	·0000,507	·0000,250	·0000,119	·0000,055
·4	·0006,428	·0003,620	·0001,975	·0001,044	·0000,535	·0000,265	·0000,127	·0000,059	·0000,027
·5	·0003,717	·0002,039	·0001,084	·0000,558	·0000,278	·0000,134	·0000,063	·0000,028	·0000,012
·6	·0002,083	·0001,113	·0000,576	·0000,289	·0000,140	·0000,066	·0000,030	·0000,013	·0000,006
·7	·0001,131	·0000,589	·0000,297	·0000,145	·0000,068	·0000,031	·0000,014	·0000,006	·0000,002
·8	·0000,595	·0000,301	·0000,148	·0000,070	·0000,032	·0000,014	·0000,006	·0000,003	·0000,001
·9	·0000,303	·0000,149	·0000,071	·0000,033	·0000,015	·0000,006	·0000,003	·0000,001	·0000,0004
1·0	·0000,149	·0000,072	·0000,033	·0000,015	·0000,006	·0000,003	·0000,001	·0000,0004	·0000,0002
1·1	·0000,071	·0000,033	·0000,015	·0000,007	·0000,003	·0000,001	·0000,0004	·0000,0002	·0000,0001
1·2	·0000,033	·0000,015	·0000,007	·0000,003	·0000,001	·0000,0005	·0000,0002	·0000,0001	·0000,0000
1·3	·0000,015	·0000,006	·0000,003	·0000,001	·0000,0005	·0000,0002	·0000,0001	·0000,0000	
1·4	·0000,006	·0000,003	·0000,001	·0000,0005	·0000,0002	·0000,0001	·0000,0000		
1·5	·0000,003	·0000,001	·0000,0004	·0000,0002	·0000,0001	·0000,0000			
1·6	·0000,001	·0000,0004	·0000,0002	·0000,0001	·0000,0000				
1·7	·0000,0004	·0000,0002	·0000,0001	·0000,0000					
1·8	·0000,0002	·0000,0001	·0000,0000						
1·9	·0000,0001	·0000,0000							
2·0	·0000,0000								

	h=1·8	h=1·9	h=2·0	h=2·1	h=2·2	h=2·3	h=2·4	h=2·5	h=2·6
k= 0	·0000,196	·0000,092	·0000,0419	·0000,0184	·0000,0079	·0000,0032	·0000,0013	·0000,0005	·0000,0002
·1	·0000,102	·0000,046	·0000,0205	·0000,0088	·0000,0036	·0000,0015	·0000,0006	·0000,0002	·0000,0001
·2	·0000,051	·0000,023	·0000,0097	·0000,0040	·0000,0017	·0000,0006	·0000,0002	·0000,0001	·0000,0000
·3	·0000,025	·0000,011	·0000,0045	·0000,0018	·0000,0007	·0000,0003	·0000,0001	·0000,0000	
·4	·0000,012	·0000,005	·0000,0020	·0000,0008	·0000,0003	·0000,0001	·0000,0000		
·5	·0000,005	·0000,002	·0000,0009	·0000,0003	·0000,0001	·0000,0000			
·6	·0000,002	·0000,001	·0000,0004	·0000,0001	·0000,0000				
·7	·0000,001	·0000,0004	·0000,0001	·0000,0000					
·8	·0000,0004	·0000,0001	·0000,0001						
·9	·0000,0002	·0000,0001	·0000,0000						
1·0	·0000,0001	·0000,0000							
1·1	·0000,0000								

d/N for r = − ·90.

	h=0	h=·1	h=·2	h=·3	h=·4	h=·5	h=·6	h=·7	h=·8
k= 0	·0717,832	·0535,024	·0385,698	·0268,454	·0180,108	·0116,302	·0072,185	·0043,011	·0024,576
·1	·0535,024	·0387,680	·0271,230	·0182,917	·0118,733	·0074,080	·0044,371	·0025,486	·0014,024
·2	·0385,698	·0271,230	·0183,863	·0119,967	·0075,240	·0045,302	·0026,157	·0014,469	·0007,661
·3	·0268,454	·0182,917	·0119,967	·0075,631	·0045,775	·0026,569	·0014,774	·0007,863	·0004,003
·4	·0180,108	·0118,733	·0075,240	·0045,775	·0026,707	·0014,928	·0007,987	·0004,087	·0001,999
·5	·0116,302	·0074,080	·0045,302	·0026,569	·0014,928	·0008,029	·0004,130	·0002,030	·0000,953
·6	·0072,185	·0044,371	·0026,157	·0014,774	·0007,987	·0004,130	·0002,041	·0000,963	·0000,434
·7	·0043,011	·0025,486	·0014,469	·0007,863	·0004,087	·0002,030	·0000,963	·0000,436	·0000,189
·8	·0024,576	·0014,024	·0007,661	·0004,003	·0001,999	·0000,953	·0000,434	·0000,189	·0000,078
·9	·0013,452	·0007,386	·0003,879	·0001,947	·0000,934	·0000,427	·0000,187	·0000,078	·0000,031
1·0	·0007,048	·0003,721	·0001,878	·0000,905	·0000,416	·0000,183	·0000,077	·0000,031	·0000,012
1·1	·0003,532	·0001,791	·0000,868	·0000,401	·0000,177	·0000,075	·0000,030	·0000,011	·0000,004
1·2	·0001,692	·0000,824	·0000,383	·0000,170	·0000,072	·0000,029	·0000,011	·0000,004	·0000,001
1·3	·0000,774	·0000,362	·0000,161	·0000,069	·0000,028	·0000,011	·0000,004	·0000,001	·0000,0005
1·4	·0000,338	·0000,151	·0000,065	·0000,026	·0000,010	·0000,004	·0000,001	·0000,0005	·0000,0001
1·5	·0000,141	·0000,060	·0000,025	·0000,010	·0000,004	·0000,001	·0000,0004	·0000,0001	·0000,0000
1·6	·0000,056	·0000,023	·0000,009	·0000,003	·0000,001	·0000,0004	·0000,0001	·0000,0000	
1·7	·0000,021	·0000,008	·0000,003	·0000,001	·0000,0004	·0000,0001	·0000,0000		
1·8	·0000,008	·0000,003	·0000,001	·0000,0004	·0000,0001	·0000,0000			
1·9	·0000,003	·0000,001	·0000,0003	·0000,0001	·0000,0000				
2·0	·0000,0009	·0000,0003	·0000,0001	·0000,0000					
2·1	·0000,0003	·0000,0001	·0000,0000						
2·2	·0000,0001	·0000,0000							
2·3	·0000,0000								

d/N for r = − ·90.

	h=·9	h=1·0	h=1·1	h=1·2	h=1·3	h=1·4	h=1·5	h=1·6	h=1·7
k= 0	·0013,452	·0007,048	·0003,532	·0001,692	·0000,774	·0000,338	·0000,141	·0000,056	·0000,021
·1	·0007,386	·0003,721	·0001,791	·0000,824	·0000,362	·0000,151	·0000,060	·0000,023	·0000,008
·2	·0003,879	·0001,878	·0000,868	·0000,383	·0000,161	·0000,065	·0000,025	·0000,009	·0000,003
·3	·0001·947	·0000,905	·0000,401	·0000,170	·0000,069	·0000,026	·0000,010	·0000,003	·0000,001
·4	·0000,934	·0000,416	·0000,177	·0000,072	·0000,028	·0000,010	·0000,004	·0000,001	·0000,0004
·5	·0000,427	·0000,183	·0000,075	·0000,029	·0000,011	·0000,004	·0000,001	·0000,0004	·0000,0001
·6	·0000,187	·0000,077	·0000,030	·0000,011	·0000,004	·0000,001	·0000,0004	·0000,0001	·0000,0000
·7	·0000,078	·0000,031	·0000,011	·0000,004	·0000,001	·0000,0005	·0000,0001	·0000,0000	
·8	·0000,031	·0000,012	·0000,004	·0000,001	·0000,0005	·0000,0001	·0000,0000		
·9	·0000,012	·0000,004	·0000,001	·0000,0005	·0000,0002	·0000,0000			
1·0	·0000,004	·0000,001	·0000,0005	·0000,0002	·0000,0000				
1·1	·0000,001	·0000,0005	·0000,0002	·0000,0000					
1·2	·0000,0005	·0000,0002	·0000,0000						
1·3	·0000,0002	·0000,0000							
1·4	·0000,0000								

	h=1·8	h=1·9	h=2·0	h=2·1	h=2·2	h=2·3
k= 0	·0000,008	·0000,003	·0000,0009	·0000,0003	·0000,0001	·0000,0000
·1	·0000,003	·0000,001	·0000,0003	·0000,0001	·0000,0000	
·2	·0000,001	·0000,0003	·0000,0001	·0000,0000		
·3	·0000,0004	·0000,0001	·0000,0000			
·4	·0000,0001	·0000,0000				
·5	·0000,0000					

d/N for r = − ·95.

	h=0	h=·1	h=·2	h=·3	h=·4	h=·5	h=·6	h=·7	h=·8
k= 0	·0505,416	·0330,242	·0202,154	·0115,376	·0061,136	·0029,965	·0013,543	·0005,629	·0002,146
·1	·0330,242	·0203,181	·0116,555	·0062,076	·0030,582	·0013,893	·0005,804	·0002,224	·0000,781
·2	·0202,154	·0116,555	·0062,393	·0030,895	·0014,107	·0005,923	·0002,282	·0000,805	·0000,260
·3	·0115,376	·0062,076	·0030,895	·0014,179	·0005,984	·0002,317	·0000,822	·0000,266	·0000,079
·4	·0061,136	·0030,582	·0014,107	·0005,984	·0002,329	·0000,830	·0000,270	·0000,080	·0000,022
·5	·0029,965	·0013,893	·0005,923	·0002,317	·0000,830	·0000,272	·0000,081	·0000,022	·0000,005
·6	·0013,543	·0005,804	·0002,282	·0000,822	·0000,270	·0000,081	·0000,022	·0000,006	·0000,001
·7	·0005,629	·0002,224	·0000,805	·0000,266	·0000,080	·0000,022	·0000,006	·0000,001	·0000,0003
·8	·0002,146	·0000,781	·0000,260	·0000,079	·0000,022	·0000,005	·0000,001	·0000,0003	·0000,0000
·9	·0000,749	·0000,250	·0000,076	·0000,021	·0000,005	·0000,001	·0000,0003	·0000,0000	
1·0	·0000,239	·0000,073	·0000,021	·0000,005	·0000,001	·0000,0003	·0000,0000		
1·1	·0000,070	·0000,020	·0000,005	·0000,001	·0000,0002	·0000,0000			
1·2	·0000,019	·0000,005	·0000,001	·0000,0002	·0000,0000				
1·3	·0000,004	·0000,001	·0000,0002	·0000,0000					
1·4	·0000,001	·0000,0002	·0000,0000						
1·5	·0000,0002	·0000,0000							
1·6	·0000,0000								

	h=·9	h=1·0	h=1·1	h=1·2	h=1·3	h=1·4	h=1·5
k= 0	·0000,749	·0000,239	·0000,070	·0000,019	·0000,004	·0000,001	·0000,0002
·1	·0000,250	·0000,073	·0000,020	·0000,005	·0000,001	·0000,0002	·0000,0000
·2	·0000,076	·0000,021	·0000,005	·0000,001	·0000,0002	·0000,0000	
·3	·0000,021	·0000,005	·0000,001	·0000,0002	·0000,0000		
·4	·0000,005	·0000,001	·0000,0002	·0000,0000			
·5	·0000,001	·0000,0003	·0000,0000				
·6	·0000,0003	·0000,0000					
·7	·0000,0000						

ON THE PROBABLE ERROR OF BISERIAL η.

By KARL PEARSON, F.R.S.

(1) In a paper in *Biometrika*, Vol. VII, pp. 248–257, entitled "On a New Method of determining Correlation where one Variable is given by alternative and the other by multiple Categories," I gave in 1910 the process of determining what is now generally termed "biserial η."

Let x be the alternative, y the multiple variate, $\bar{x}_y$ the distance from the division between the alternative categories of the mean of the array of x's corresponding to a given value of y, ${}_y\sigma_x$ its standard deviation and n_y its frequency. Let $\bar{x}$, σ_x and N be the corresponding quantities for the marginal total. Then, if

$$\gamma = \bar{x}/\sigma_x, \quad \gamma_y = \bar{x}_y/{}_y\sigma_x,$$

I showed that

$$\eta = \left[\frac{\frac{1}{N}S\left\{n_y\left(\frac{\bar{x}_y}{{}_y\sigma_x}\right)^2\right\} - \left(\frac{\bar{x}}{\sigma_x}\right)^2}{1 + \frac{1}{N}S\left\{n_y\left(\frac{\bar{x}_y}{{}_y\sigma_x}\right)^2\right\}}\right]^{\frac{1}{2}} \quad \text{.....(i),}$$

and explained that η might be found from the usual tables of the probability integral. I did not publish the probable error of this method of determining "biserial η" at the time, and it has remained one of the few outstanding cases where probable errors were still wanting. I now add the determination of the probable error, and owing to the kindness of my colleagues, Miss Ethel M. Elderton and Miss B. M. Cave, am able to give a table for its fairly easy computation.

(2) I take as my biserial table the following:

n_{11}	n_{21}	...	n_{1s}	.....	ν_1
n_{12}	n_{22}	...	n_{2s}	.....	ν_2
n_1	n_2	...	n_s	.....	N

Here n_s stands for n_y, and the y variate is the horizontal or multiple category variate. We shall write

$$\kappa^2 = \frac{1}{N}S\,(n_s\gamma_s^2), \quad \gamma^2 = (\bar{x}/\sigma_x)^2 \text{.....(ii),}$$

and thus

$$\eta^2 = \frac{\kappa^2 - \gamma^2}{1 + \kappa^2} = 1 - \frac{1 + \gamma^2}{1 + \kappa^2}.$$

Accordingly to a first approximation

$$\eta\delta\eta = \frac{1+\gamma^2}{(1+\kappa^2)^2}\kappa\delta\kappa - \frac{\gamma\delta\gamma}{1+\kappa^2},$$

where η, κ and γ are now mean values and $\delta\eta$, $\delta\kappa$ and $\delta\gamma$ are variations from those means. Squaring, summing for all values, and dividing by the number of cases:

$$\eta^2\sigma_\eta^2 = \frac{(1-\eta^2)^4}{(1+\gamma^2)^2}\kappa^2\sigma_\kappa^2 + \frac{\gamma^2}{(1+\kappa^2)^2}\sigma_\gamma^2 - \frac{2\gamma\kappa(1+\gamma^2)}{(1+\kappa^2)^3}\text{ Mean }(\delta\kappa\delta\gamma) \quad ...(\text{iii}).$$

Hence to find σ_η we require to evaluate σ_κ, σ_γ and Mean $(\delta\gamma\delta\kappa)$. We shall now proceed to the consideration of these quantities.

We have $$\nu_1/N = \frac{1}{\sqrt{2\pi}}\int_\gamma^\infty e^{-\frac{1}{2}x^2}dx.$$

Hence
$$\delta\nu_1/N = -\delta\gamma\frac{1}{\sqrt{2\pi}}e^{-\frac{1}{2}x^2}$$
$$= -\delta\gamma z,$$

where z is the ordinate of the frequency curve of the marginal total at the boundary of the alternative categories.

Thus $$\sigma^2_{\nu_1}/N^2 = \sigma_\gamma^2 z^2.$$

But if the sample has been taken from an indefinitely large population

$$\sigma^2_{\nu_1} = \nu_1(1-\nu_1/N).$$

Accordingly $$\sigma_\gamma^2 = \frac{\nu_1\nu_2}{N^3z^2} \quad .....(\text{iv}).$$

Again $$\kappa\delta\kappa = S(\kappa_s\delta\kappa_s),$$

where $$\kappa_s^2 = \frac{n_s}{N}\gamma_s^2,$$

$$\kappa^2\sigma_\kappa^2 = S(\kappa_s^2\sigma^2_{\kappa_s}) + 2S\{\kappa_s\kappa_{s'}\text{ Mean }(\delta\kappa_s\delta\kappa_{s'})\} \quad .....(\text{v}).$$

We require therefore to find $\sigma^2_{\kappa_s}$ and Mean $(\delta\kappa_s\delta\kappa_s')$. Now

$$2\kappa_s\delta\kappa_s = \frac{\delta n_s}{N}\gamma_s^2 + 2\frac{n_s}{N}\gamma_s\delta\gamma_s \quad .....(\text{vi}).$$

But $$n_{1s} = n_s\frac{1}{\sqrt{2\pi}}\int_{\gamma_s}^\infty e^{-\frac{1}{2}x^2}dx,$$

$$\frac{\delta n_{1s}}{n_s} - \frac{n_{1s}\delta n_s}{n_s^2} = -\delta\gamma_s z_s \quad .....(\text{vii}).$$

And accordingly:

$$\frac{\sigma^2_{n_{1s}}}{n_s^2} - \frac{2n_{1s}}{n_s^3}\text{Mean }(\delta n_{1s}\delta n_s) + \frac{n_{1s}^2}{n_s^4}\sigma^2_{n_s} = z_s^2\sigma^2_{\gamma_s}.$$

But $$\sigma^2_{n_{1s}} = n_{1s}\left(1 - \frac{n_{1s}}{N}\right), \quad \sigma^2_{n_s} = n_s\left(1 - \frac{n_s}{N}\right),$$

$$\text{Mean}\,(\delta n_{1s}\delta n_s) = \text{Mean}\,(\delta n_{1s}\delta n_{2s}) + \text{Mean}\,(\delta n_{1s})^2$$

$$= -\frac{n_{1s}n_{2s}}{N} + n_{1s}\left(1 - \frac{n_{1s}}{N}\right)$$

$$= n_{1s}\left(1 - \frac{n_s}{N}\right).$$

Thus $$\sigma^2_{\gamma_s} = \frac{n_{1s}n_{2s}}{n_s^3 z_s^2} \quad \text{.....(viii).}$$

It will be seen that (viii) is of the same form as (iv), although the value of n_s is variable, while that of N is constant.

Now multiply (vii) by δn_s and sum and we have

$$\frac{n_{1s}}{n_s}\left(1 - \frac{n_s}{N}\right) - \frac{n_{1s}}{n_s^2}n_s\left(1 - \frac{n_s}{N}\right) = -z_s\,\text{Mean}\,(\delta\gamma_s\delta n_s).$$

Thus $$\text{Mean}\,(\delta\gamma_s\delta n_s) = 0 \quad \text{.....(ix).}$$

Returning to (vi), squaring and summing, we find

$$4\kappa_s^2\sigma^2_{\kappa_s} = \frac{1}{N^2}\left\{\gamma_s^4 n_s\left(1 - \frac{n_s}{N}\right) + 4n_s^2\gamma_s^2\,\frac{n_{1s}n_{2s}}{n_s^3 z_s^2}\right\},$$

or, $$\kappa_s^2\sigma^2_{\kappa_s} = \frac{1}{N^2}\left\{\tfrac{1}{4}\gamma_s^4 n_s\left(1 - \frac{n_s}{N}\right) + \frac{n_{1s}n_{2s}}{n_s}\left(\frac{\gamma_s}{z_s}\right)^2\right\} \quad \text{.....(x).}$$

Again returning to (vi), multiplying it by the corresponding values of $2\kappa_{s'}\delta\kappa_{s'}$ and summing, we reach

$$4\kappa_s\kappa_{s'}\,\text{Mean}\,(\delta\kappa_s\delta\kappa_{s'}) = -\frac{n_s n_{s'}}{N^3}\gamma_s^2\gamma_{s'}^2 + 4\,\frac{n_s n_{s'}}{N^2}\gamma_s\gamma_{s'}\,\text{Mean}\,(\delta\gamma_s\delta\gamma_{s'})$$

$$+ 2\,\frac{n_s}{N^2}\gamma_s\gamma_{s'}^2\,\text{Mean}\,(\delta n_{s'}\delta\gamma_s) + 2\,\frac{n_{s'}}{N^2}\gamma_{s'}\gamma_s^2\,\text{Mean}\,(\delta n_s\delta\gamma_{s'}).$$

But

$$\text{Mean}\,(\delta\gamma_s\delta\gamma_{s'}) = \frac{1}{z_s z_{s'}}\left(-\frac{n_{1s}n_{1s'}}{n_s n_{s'}N} - \frac{n_{1s}n_{1s'}}{n_s^2 n_{s'}^2}\,\frac{n_s n_{s'}}{N} + \frac{n_{1s'}}{n_s n_{s'}^2}\,\frac{n_{1s}n_{s'}}{N} + \frac{n_{1s}}{n_s^2 n_{s'}}\,\frac{n_{1s'}n_s}{N}\right) = 0.$$

Further multiplying (vii) by $\delta n_{s'}$ we find

$$\text{Mean}\,(\delta n_{s'}\delta\gamma_s) = -\frac{1}{z_s}\left(-\frac{n_{1s}n_{s'}}{n_s N} + \frac{n_{1s}n_s n_{s'}}{n_s^2 N}\right) = 0, \text{ also.}$$

Accordingly $$\kappa_s\kappa_{s'}\,\text{Mean}\,(\delta\kappa_s\delta\kappa_{s'}) = -\frac{1}{4}\,\frac{n_s n_{s'}}{N^3}\gamma_s^2\gamma_{s'}^2 \quad \text{.....(xi).}$$

Returning to (v) we can now evaluate it by aid of (x) and (xi); thus we have

$$\kappa^2\sigma_\kappa^2 = \frac{1}{N^2}\left\{\tfrac{1}{4}S\left\{\gamma_s^4 n_s\left(1 - \frac{n_s}{N}\right)\right\} + S\left\{\frac{n_{1s}n_{2s}}{n_s}\left(\frac{\gamma_s}{z_s}\right)^2\right\} - \tfrac{1}{2}S\,(n_s n_{s'}\gamma_s^2\gamma_{s'}^2)\right\} \quad \text{(xii).}$$

It now remains to find Mean $(\delta\kappa\delta\gamma)$. We have:

$$\kappa \text{ Mean } (\delta\kappa\delta\gamma) = S\,(\kappa_s\,\{\text{Mean } (\delta\kappa_s\delta\gamma)\})$$

$$= \tfrac{1}{2}S\left\{\frac{\gamma_s^2}{N}\text{ Mean }(\delta\gamma\delta n_s)\right\} + S\left\{\frac{n_s\gamma_s}{N}\text{ Mean }(\delta\gamma_s\delta\gamma)\right\}.$$

We must now find Mean $(\delta\gamma\delta n_s)$ and Mean $(\delta\gamma_s\delta\gamma)$.

$$\text{Mean }(\delta\gamma\delta n_s) = -\frac{\text{Mean }(\delta\nu_1\delta n_s)}{Nz}$$

$$= -\frac{1}{Nz}\left(n_{1s} - \frac{\nu_1 n_s}{N}\right).$$

$$\text{Mean }(\delta\gamma_s\delta\gamma) = \text{Mean}\left\{\frac{\delta\nu_1}{Nz}\left(\frac{\delta n_{1s}}{n_s z_s} - \frac{n_{1s}\delta n_s}{n_s^2 z_s}\right)\right\}$$

$$= \frac{1}{Nzn_sz_s}\left\{n_{1s}\left(1-\frac{\nu_1}{N}\right) - \frac{n_{1s}}{n_s}\left(n_{1s} - \frac{\nu_1 n_s}{N}\right)\right\}$$

$$= \frac{n_{1s}}{Nzn_sz_s}\left(1 - \frac{n_{1s}}{n_s}\right).$$

Thus

$$\kappa \text{ Mean } (\delta\kappa\delta\gamma) = -\frac{1}{N^2z}\left\{\tfrac{1}{2}S\,(n_{1s}\gamma_s^2) - \frac{\nu_1}{2N}S\,(n_s\gamma_s^2) - S\left(\frac{n_{1s}n_{2s}}{n_sz_s}\gamma_s\right)\right\} \quad \text{(xiii)}.$$

We can now substitute in (iii) from (iv), (xii) and (xiii) and obtain σ_η^2. We have

$$\eta^2\sigma_\eta^2 = \frac{(1-\eta^2)^4}{(1+\gamma^2)^2}\left[\frac{1}{N^2}\left\{\tfrac{1}{4}S\left(\gamma_s^4 n_s\left(1-\frac{n_s}{N}\right)\right) + S\left(\frac{n_{1s}n_{2s}}{n_s}\left(\frac{\gamma_s}{z_s}\right)^2\right) - \tfrac{1}{2}S\,(n_sn_{s'}\gamma_s^2\gamma_{s'}^2)\right\}\right]$$

$$+ \frac{(1-\eta^2)^2}{(1+\gamma^2)^2}\frac{\nu_1\nu_2}{N^3}\left(\frac{\gamma}{z}\right)^2$$

$$+ \frac{(1-\eta^2)^3}{(1+\gamma^2)^2}\frac{1}{N^2}\frac{\gamma}{z}\left\{S\,(n_{1s}\gamma_s^2) - \frac{\nu_1}{N}S\,(n_s\gamma_s^2) - 2S\left(\frac{n_{1s}n_{2s}}{n_s}\frac{\gamma_s}{z_s}\right)\right\}$$

$$= \frac{(1-\eta^2)^2}{N(1+\gamma^2)^2}\left[\frac{\nu_1\nu_2}{N^2}\left(\frac{\gamma}{z}\right)^2 + \frac{(1-\eta^2)^2}{4}\left\{S\left(\frac{\gamma_s^4 n_s}{N}\right) - \left(S\left(\frac{n_s\gamma_s^2}{N}\right)\right)^2\right\}\right.$$

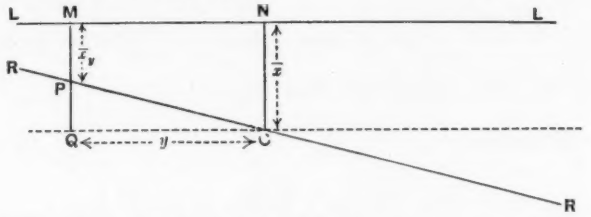
$$+ (1-\eta^2)^2 S\left\{\frac{n_{1s}n_{2s}}{n_sn_s}\frac{n_s}{N}\left(\frac{\gamma_s}{z_s}\right)^2\right\}$$

$$\left. + (1-\eta^2)\left(\frac{\gamma}{z}\right)\left\{S\left(\frac{n_{1s}\gamma_s^2}{N}\right) - \frac{\nu_1}{N}S\left(\frac{n_s}{N}\gamma_s^2\right) - 2S\left(\frac{n_{1s}n_{2s}}{n_sN}\left(\frac{\gamma_s}{z_s}\right)\right)\right\}\right]$$

.....(xiv).

Now we know all the quantities in the sums on the right of (xiv), because γ_s has had to be found for each array, and z_s can be at once determined from $\bar{x}_s/_s\sigma_x$ which is known. But the labour would be very considerable and hardly commensurate with the result desired, i.e. an approximate measure of the accuracy of determining the correlation by the biserial η method. We shall accordingly investigate the values of the above terms on the hypothesis of a large number of

arrays with linear regression and homoscedasticity, or even with a complete Gaussian distribution of frequency.



In the first place let the division between the two series be the line LL. Let C be the centroid of the frequency surface and RR the regression line. Let $\bar{x} = CN$ and $\bar{x}_y = PM$. Then by the equation to the regression line (correlation $r = \eta$)

$$PQ/\sigma_x = rCQ/\sigma_y,$$

$$(\bar{x} - \bar{x}_y)/\sigma_x = ry/\sigma_y,$$

$$\frac{\bar{x}_y}{\sigma_x\sqrt{1-r^2}} = \frac{1}{\sqrt{1-r^2}}\left(\frac{\bar{x}}{\sigma_x} - r\frac{y}{\sigma_y}\right),$$

$$\gamma_s = \frac{1}{\sqrt{1-r^2}}(\gamma - ry') \quad \text{.....(xv).}$$

Hence

$$\gamma_s^2 = \frac{1}{1-r^2}(\gamma^2 - 2ry'\gamma + r^2y'^2),$$

$$\gamma_s^4 = \frac{1}{(1-r^2)^2}(\gamma^4 - 4ry'\gamma^3 + 6r^2y'^2\gamma^2 - 4r^3y'^3\gamma + r^4y'^4).$$

Thus, since we may suppose $S(n_s y') = S(n_s y'^3) = 0$ approximately:

$$S(n_s\gamma_s^2)/N = \frac{1}{1-r^2}(\gamma^2 + r^2),$$

$$S(n_s\gamma_s^4)/N = \frac{1}{(1-r^2)^2}(\gamma^4 + 6r^2\gamma^2 + r^4\beta_2'),$$

where β_2' is the second statistical β-constant for the y'-array, and since to our approximation $\eta = r$:

$$\frac{(1-\eta^2)^2}{4}\left[\frac{S(n_s\gamma_s^4)}{N} - \left\{\frac{S(n_s\gamma_s^2)}{N}\right\}^2\right] = \eta^2\{\gamma^2 + \tfrac{1}{4}\eta^2(\beta_2' - 1)\} \text{.....(xvi).}$$

Again
$$S\left(\frac{n_{1s}\gamma_s^2}{N}\right) = \frac{1}{(1-r^2)}S\left\{\frac{n_{1s}}{N}(\gamma^2 - 2r\gamma y' + r^2y'^2)\right\}$$

$$= \frac{1}{(1-r^2)}\left\{\frac{\nu_1\gamma^2}{N} - 2r\gamma\frac{S(n_{1s}y')}{N} + r^2\frac{S(n_{1s}y'^2)}{N}\right\}.$$

But as in the theory of biserial r*

$$r = \frac{S(n_{1s}y')}{N}\Big/\left(z\frac{\nu_1}{N}\right),$$

* *Biometrika*, Vol. VII. p. 97.

and thus $$S\left(\frac{n_{1s}y'}{N}\right) = rz\,\frac{\nu_1}{N}.$$

Again $$\frac{S\,(n_{1s}y'^2)}{N} = \frac{1}{N}\,S'\left\{n_s\,(1-r^2) + r^2\,\frac{x^2}{\sigma_x^{\,2}}\right\},$$

where the summation S' is from $x = \bar{x}$ to ∞ ; thus

$$\frac{S\,(n_{1s}y'^2)}{N} = \frac{\nu_1}{N}\,(1-r^2) + r^2\int_\gamma^\infty \frac{1}{\sqrt{2\pi}}\,x^2 e^{-\frac{1}{2}x^2}\,dx$$

$$= \frac{\nu_1}{N}\,(1-r^2) + r^2\gamma z + r^2\,\frac{\nu_1}{N}$$

$$= \frac{\nu_1}{N} + r^2\gamma z.$$

Accordingly we have

$$S\left(\frac{n_{1s}\gamma_s^{\,2}}{N}\right) = \frac{1}{1-\eta^2}\left\{\frac{\nu_1}{N}\,(\gamma^2 - 2\eta^2\gamma z + \eta^2) + \eta^4\gamma z\right\},$$

and accordingly

$$(1-\eta^2)\,\frac{\gamma}{z}\left\{\frac{S\,(n_{1s}\gamma_s^{\,2})}{N} - \frac{\nu_1}{N}\,S\left(\frac{n_s\gamma_s^{\,2}}{N}\right)\right\} = \frac{\gamma}{z}\left\{\frac{\nu_1}{N}\,(\gamma^2 - 2\eta^2\gamma z + \eta^2 - \gamma^2 - \eta^2) + \eta^4\gamma z\right\}$$

$$= \eta^2\gamma^2\left(\eta^2 - 2\,\frac{\nu_1}{N}\right) \qquad \text{.....(xvii).}$$

Now substitute (xvi) and (xvii) in (xiv) and we find

$$\eta^2\sigma_\eta^{\,2} = \frac{(1-\eta^2)^2}{N\,(1+\gamma^2)^2}\left[\frac{\nu_1\nu_2}{N^2}\left(\frac{\gamma}{z}\right)^2 + \eta^2\,(\gamma^2 + \tfrac{1}{2}\eta^2) + \eta^2\gamma^2\left(\eta^2 - 2\,\frac{\nu_1}{N}\right)\right.$$

$$\left. + (1-\eta^2)^2\,S\left\{\frac{n_{1s}n_{2s}}{n_s n_s}\left(\frac{\gamma_s}{z_s}\right)^2\frac{n_s}{N}\right\} - 2\,(1-\eta^2)\,\frac{\gamma}{z}\,S\left\{\frac{n_{1s}n_{2s}}{n_s n_s}\,\frac{\gamma_s}{z_s}\,\frac{n_s}{N}\right\}\right].$$

Or,

$$\sigma_\eta^{\,2} = \frac{(1-\eta^2)^2}{N\,(1+\gamma^2)^2}\left[\tfrac{1}{2}\eta^2 + \gamma^2\left(\eta^2 + \frac{\nu_2 - \nu_1}{N}\right) + \frac{1}{\eta^2}\left(\frac{\gamma}{z}\right)^2\left\{\frac{\nu_1\nu_2}{N^2} - S\left(\frac{n_{1s}n_{2s}}{n_s N}\right)\right\}\right.$$

$$\left. + \frac{1}{\eta^2}\,S\left\{\frac{n_{1s}n_{2s}}{n_s N}\left((1-\eta^2)\,\frac{\gamma_s}{z_s} - \frac{\gamma}{z}\right)^2\right\}\right] \qquad \text{.....(xviii).}$$

This form for the value of $\sigma_\eta^{\,2}$ shows that the probable error of η does not become infinite when $\eta = 0$; for in that case, we shall have $\frac{n_{1s}}{n_s} = \frac{\nu_1}{N}$ for all values of s, and $\frac{\gamma_s}{z_s} = \frac{\gamma}{z}$, so that the last two terms in $1/\eta^2$ take indeterminate forms which need evaluating. For calculation it is best to use the form

$$\sigma_\eta^{\,2} = \frac{(1-\eta^2)^2}{N\,(1+\gamma^2)^2}\left[\tfrac{1}{2}\eta^2 + \gamma^2\left(\eta^2 + \frac{\nu_2 - \nu_1}{N}\right)\right.$$

$$\left. + \frac{1}{\eta^2}\left\{\frac{\nu_1\nu_2}{N^2}\left(\frac{\gamma}{z}\right)^2 + (1-\eta^2)^2\,S\left(\frac{n_{1s}n_{2s}}{n_s n_s}\left(\frac{\gamma_s}{z_s}\right)^2\frac{n_s}{N}\right) - 2\,(1-\eta^2)\,\frac{\gamma}{z}\,S\left(\frac{n_{1s}n_{2s}}{n_s n_s}\left(\frac{\gamma_s}{z_s}\right)\frac{n_s}{N}\right)\right\}\right]$$

.....(xix).

The functions $$\psi_s'' = \frac{n_{1s}.n_{2s}}{n_s.n_s}\left(\frac{\gamma_s}{z_s}\right)^2 = \tfrac{1}{2}(1-\alpha^2)\left(\frac{x}{z}\right)^2.$$

$$\psi_s' = \frac{n_{1s}.n_{2s}}{n_s.n_s}\frac{\gamma_s}{z_s} = \tfrac{1}{2}(1-\alpha^2)\frac{x}{z}.$$

where x, $\frac{1}{2}(1+\alpha)$ and z are the values given in the tables of the probability function, have been calculated by my colleagues Miss Ethel M. Elderton and Miss B. M. Cave in the table given on p. 302 below. The labour was considerable as owing to the smallness of z for high values of x, the quantities involved had to be calculated to many places of decimals. If this table be used we can put (xix) in the form:

$$\sigma_\eta^2 = \frac{(1-\eta^2)^2}{N(1+\gamma^2)^2}\left[\tfrac{1}{2}\eta^2 + \gamma^2\left(\eta^2 + \frac{\nu_2-\nu_1}{N}\right) + \frac{1}{\eta^2}\left\{\frac{\nu_1\nu_2}{N^2}\left(\frac{\gamma}{z}\right)^2 + (1-\eta^2)^2 S\left(\psi_s''\frac{n_s}{N}\right) - 2(1-\eta^2)\frac{\gamma}{z}S\left(\psi_s'\frac{n_s}{N}\right)\right\}\right] \quad \text{.....(xx).}$$

I propose to illustrate this on the following example correlating nature of vaccination and severity of attack in the case of smallpox.

Severity of Attack.

Nature of Vaccination	(1) Haemorrhagic	(2) Confluent	(3) Abundant	(4) Sparse	(5) Very sparse	Totals
0 to 25 yrs. since Over 25 yrs. or not at all	5 44	38 251	120 388	176 308	148 211	487 1202
Totals	49	289	508	484	359	1689
Positions of means	$\bar{x}_1/\sigma_1 = \gamma_1$ $= +1{\cdot}2700$	$\bar{x}_2/\sigma_2 = \gamma_2$ $= +1{\cdot}1194$	$\bar{x}_3/\sigma_3 = \gamma_3$ $= +{\cdot}7185$	$\bar{x}_4/\sigma_4 = \gamma_4$ $= +{\cdot}3488$	$\bar{x}_5/\sigma_5 = \gamma_5$ $= -{\cdot}2218$	$\bar{x}/\sigma_x = \gamma$ $= {\cdot}5583$
Ordinates at dichotomic line	$z_1 = {\cdot}17810$	$z_2 = {\cdot}21321$	$z_3 = {\cdot}30818$	$z_4 = {\cdot}37540$	$z_5 = {\cdot}38925$	$z = {\cdot}34137$
n_{1s}/n_s	·10204	·15149	·23622	·36364	·41226	$\frac{\nu_1}{N} =$ ·28834
n_{2s}/n_s	·89796	·86851	·76378	·63636	·58774	$\frac{\nu_2}{N} =$ ·71166
n_s/N	·02901	·17111	·30077	·28656	·21255	Sum = 1·00000
n_{1s}/N	·00296	·02250	·07105	·10420	·08763	Sum = ·28834 = ν_1/N
γ_s^2	1·61290	1·25306	·51624	·12166	·04920	$\gamma^2 =$ ·31170
γ_s/z_s	7·13083	5·25022	2·33143	·92914	·56981	$\gamma/z =$ 1·63547
$(\gamma_s/z_s)^2$	50·84867	27·56489	5·43556	·86331	·32469	$(\gamma/z)^2 =$ 2·67476
$n_s\gamma_s^2/N$	·04679	·21441	·15527	·03486	·01046	$\kappa^2 =$ ·46179
$n_s\gamma_s^4/N$	·07547	·26867	·06812	·00424	·00051	$\gamma^4 =$ ·09716
$n_{1s}\gamma_s^2/N$	·00477	·02819	·03668	·01268	·00431	Sum = ·08663
$\frac{n_{1s}}{n_s}\frac{n_{2s}}{n_s}\frac{n_s}{N}\frac{\gamma_s}{z_s}$	·018955	·102594	·126515	·061613	·029346	Sum = ·339023
$\frac{n_{1s}}{n_s}\frac{n_{2s}}{n_s}\frac{n_s}{N}\left(\frac{\gamma_s}{z_s}\right)^2$	·135162	·538639	·294961	·057247	·016722	Sum = 1·042731

Now $\eta^2 = (\kappa^2 - \gamma^2)/(1 + \kappa^2) = \cdot 102{,}6755$ and $\eta = \cdot 3204$.

Again, $S(n_s\gamma_s^4)\,N = \cdot 41701$ actually; but if it be calculated from the value of p. 296, i.e.

$$S(n_s\gamma_s^4)\,N = \frac{1}{(1-\eta^2)^2}(\gamma^4 + 6\eta^2\gamma^2 + \eta^4\beta_2'),$$

taking $\beta_2' = 3$, its value $= \cdot 39843$, which is approximate enough for most practical purposes,

$$\frac{(1-\eta^2)^2}{4}\left\{S\left(\frac{\gamma_s^4 n_s}{N}\right) - \left(\frac{S(n_s\gamma_s^2)}{N}\right)^2\right\},$$

taken actually, $= \cdot 201{,}298\,\{\cdot 41701 - (\cdot 46179)^2\} = \cdot 041{,}0165$,

while the approximate value in (xvi) gives $\cdot 037{,}2751$.

In the next place

$$(1-\eta^2)\frac{\gamma}{z}\left\{S\left(\frac{n_{1s}\gamma_s^2}{N}\right) - \frac{\nu_1}{N}S\left(\frac{n_s}{N}\gamma_s^2\right)\right\},$$

taken actually, $= -\cdot 068{,}270$, while the approximate value in (xvii) gives $-\cdot 01517$.

Further*,

$$(1-\eta^2)\frac{\gamma}{z} \times 2S\left(\frac{n_{1s}n_{2s}}{n_s n_s}\frac{n_s}{N}\frac{\gamma_s}{z_s}\right) = 1\cdot 794{,}649 \times 1\cdot 63547 \times \cdot 339{,}023\dagger$$
$$= \cdot 995{,}062,$$

and will be seen to be of wholly different order to the terms already computed.

Again,
$$\frac{\nu_1\nu_2}{N^2}\left(\frac{\gamma}{z}\right)^2 = \cdot 28834 \times \cdot 71166 \times 2\cdot 67476$$
$$= \cdot 548{,}861.$$

Lastly we have the term

$$(1-\eta^2)^2 S\left\{\frac{n_{1s}n_{2s}}{n_s n_s}\frac{n_s}{N}\left(\frac{\gamma_s}{z_s}\right)^2\right\} = \cdot 805{,}191 \times 1\cdot 042{,}731\ddagger$$
$$= \cdot 839{,}598.$$

Thus substituting in (xiv) we have

$$\sigma_\eta^2 = \frac{(1-\eta^2)^2}{N\eta^2(1+\gamma^2)^2}\{\cdot 548{,}861 + \cdot 041{,}0165 + \cdot 839{,}598 - \cdot 068{,}270 - \cdot 995{,}062\}$$
$$= \frac{\cdot 805{,}191 \times \cdot 366{,}144}{1689 \times \cdot 102{,}6755 \times (1\cdot 31170)^2} = \cdot 000{,}988{,}065.$$
$$\therefore\ \sigma_\eta = \cdot 03143,$$

and
$$\text{Probable Error} = \cdot 67449\sigma_\eta = \cdot 0212.$$

* In this case γ_s is of the same sign throughout, but caution must be taken to see from the data whether for certain arrays it changes sign.

† Found from the table of ψ', this is $\cdot 338{,}961$.

‡ Found from the table of ψ'', this is $1\cdot 044{,}911$. The differences in this and the previous value for ψ' depend on cutting off at 5 or 6 decimal places and in using in the different processes only first differences.

For comparison we will investigate the value as given by the less exact formula (xix):

$$\sigma_\eta^2 = \frac{\cdot 805,191}{1689 \times (1\cdot 31170)^2}\Big[\cdot 051,338 + \cdot 31170\,(\cdot 102,676 + \cdot 423,327) + 9\cdot 739,422\,(\cdot 548,861 + \cdot 839,598 - \cdot 995,062)\Big]$$

$$= \cdot 000,277,077 \times 4\cdot 046,752 = \cdot 001,121,26.$$

Hence $$\sigma_\eta = \cdot 03349,$$

and $$\text{Probable Error} = \cdot 0226.$$

Thus for all practical purposes (xix) gives as good a result as the more lengthy formula (xiv). Had the value $r = \cdot 3204$ been computed by the product moment method for a population of 1689 the probable error would have been ·0147. Thus the accuracies of the product-moment and the biserial η methods appear to be about roughly in the ratio of 2 to 3 for this case.

We will now turn back to the formula (xviii) and endeavour to express the quantities in curled brackets in powers of r or η. We have

$$z_s = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}\gamma_s^2} = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}\frac{(\gamma - ry')^2}{1-r^2}}$$

$$= \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}\gamma^2}\{1 + r\gamma y' + \tfrac{1}{2}r^2(\gamma^2 y'^2 - y'^2 - \gamma^2)\}.$$

Hence

$$\frac{\gamma_s}{z_s} = \frac{\gamma}{z}\left(1 - r\frac{y'}{\gamma} + \tfrac{1}{2}r^2\right)\{1 - r\gamma y' + \tfrac{1}{2}r^2(\gamma^2 y'^2 + y'^2 + \gamma^2)\}$$

$$= \frac{\gamma}{z}\left\{1 - ry'\frac{1+\gamma^2}{\gamma} + r^2(y'^2) + \tfrac{1}{2}r^2(1+\gamma^2)(1+y'^2)\right\} \quad \text{.....(xxi).}$$

Again $$\frac{n_{1s}}{n_s} = \frac{1}{\sqrt{2\pi}}\int_{\gamma_s}^{\infty} e^{-\frac{1}{2}x^2}\,dx,$$

and $$\gamma_s = \gamma - ry' + \tfrac{1}{2}r^2\gamma.$$

Thus $$\frac{n_{1s}}{n_s} = \frac{\nu_1}{N} + \frac{1}{\sqrt{2\pi}}\int_{\gamma - ry' + \frac{1}{2}r^2\gamma}^{\gamma} e^{-\frac{1}{2}x^2}\,dx.$$

Take $x = \gamma - x'$, so that x' will be small, thus

$$\frac{n_{1s}}{n_s} = \frac{\nu_1}{N} + z\int_0^{ry' - \frac{1}{2}r^2\gamma}(1 + \gamma x' + \tfrac{1}{2}\gamma^2 x'^2)(1 - \tfrac{1}{2}x'^2)\,dx'$$

$$= \frac{\nu_1}{N} + z(ry' - \tfrac{1}{2}\gamma r^2 + \tfrac{1}{2}r^2\gamma y'^2) + \text{etc.}$$

Similarly:

$$\frac{n_{2s}}{n_s} = \frac{\nu_2}{N} - z(ry' - \tfrac{1}{2}\gamma r^2 + \tfrac{1}{2}r^2\gamma y'^2) - \text{etc.},$$

$$\frac{n_{1s}n_{2s}}{n_s n_s} = \frac{\nu_1\nu_2}{N^2} - z\frac{\nu_2 - \nu_1}{N}ry' - z^2r^2y'^2 + Z\frac{\nu_2 - \nu_1}{N}\tfrac{1}{2}\gamma r^2(1 - y'^2) + \text{etc.....(xxii).}$$

But $$S\left(\frac{n_s}{N}\right) = 1, \quad \frac{S(n_s y')}{N} = 0, \quad S\left(\frac{n_s y'^2}{N}\right) = 1,$$

and accordingly: $$S\left(\frac{n_{1s} n_{2s}}{n_s n_s} \frac{n_s}{N}\right) = \frac{\nu_1 \nu_2}{N^2} - z^2 \nu^2 + \text{etc.}$$

We have then

$$\frac{1}{\eta^2}\left(\frac{\gamma}{z}\right)^2 \left\{\frac{\nu_1 \nu_2}{N^2} - S\left(\frac{n_{1s} n_{2s}}{n_s N}\right)\right\} = \gamma^2 + \text{terms in } \eta^2 \text{ .....(xxiii).}$$

Again turning back to (xxi):

$$(1-\eta^2)\frac{\gamma_s}{z_s} - \frac{\gamma}{z} = \frac{\gamma}{z}\left(-ry'\frac{1+\gamma^2}{\gamma} + r^2(y'^2-1)\right) + \tfrac{1}{2}r^2(1+\gamma^2)(1+y'^2).$$

Square this, multiply by (xxii) and n_s/N, sum and note that sum of odd powers of y' go out. We find

$$\frac{1}{\eta^2} S\left\{\frac{n_{1s} n_{2s}}{n_s N}\left((1-\eta^2)\frac{\gamma_s}{z_s} - \frac{\gamma}{z}\right)^2\right\} = \frac{\nu_1 \nu_2}{N^2}\frac{(1+\gamma^2)^2}{z^2} + \text{terms in } \eta^2 \text{...(xxiv).}$$

Substituting (xxiii) and (xxiv) in (xviii) we deduce

$$\sigma_\eta{}^2 = \frac{(1-\eta^2)^2}{N}\left[\frac{\gamma^2}{(1+\gamma^2)^2}\frac{\nu_2 - \nu_1}{N} + \frac{\gamma^2}{(1+\gamma^2)^2} + \frac{\nu_1 \nu_2}{N^2 z^2} + \text{terms in } \eta^2\right]$$

$$= \frac{(1-\eta^2)^2}{N}\left[\frac{\nu_1 \nu_2}{N^2 z^2} + \frac{2\nu_2}{N}\frac{\gamma^2}{(1+\gamma^2)^2} + \text{terms in } \eta^2\right].$$

$$\text{Probable Error of } \eta = \frac{\cdot 67449\,(1-\eta^2)}{\sqrt{N}}\left\{\frac{\nu_1 \nu_2}{N^2 z^2} + \frac{2\nu_2}{N}\frac{\gamma^2}{(1+\gamma^2)^2}\right\}^{\frac{1}{2}}$$

$$\times (1 + \text{terms in } \eta^2 \text{ and higher powers}) \text{ .....(xxv).}$$

This expression is of value for two reasons. First it indicates that the probable error of η found for non-associated variates is

$$= \frac{\cdot 67449}{\sqrt{N}}\left\{\frac{\nu_1 \nu_2}{N^2 z^2} + \frac{2\nu_2}{N}\frac{\gamma^2}{(1+\gamma^2)^2}\right\}^{\frac{1}{2}} \text{ .....(xxvi).}$$

And secondly (xxv) may give a good approximate value of the probable error of η, when we neglect the last factor altogether, say for values of η under ·4 or ·5. Thus in the illustration given above

$$\left\{\frac{\nu_1 \nu_2}{N^2 z^2} + \frac{2\nu_2}{N}\frac{\gamma^2}{(1+\gamma^2)^2}\right\}^{\frac{1}{2}} = \left\{\frac{\cdot 548{,}861}{\cdot 31170} + 1{\cdot}42332\,\frac{\cdot 31170}{(1{\cdot}31170)^2}\right\}^{\frac{1}{2}}$$

$$= 1{\cdot}4208.$$

We have therefore to multiply the probable error as given by the product-moment method, i.e. in our case ·0147 by 1·4208, giving ·0209, in fair accordance with the more accurate value ·0226, it being remembered that a probable error is rarely worth more than one or two significant figures.

Table of Values of the Biserial η *Functions,* ψ' *and* ψ''.

x	ψ'	ψ''	x	ψ'	ψ''
00	0	0	2·00	·82357	30·5075
·05	·03132	·00393	2·05	·83084	34·9079
·10	·06258	·01577	2·10	·83770	39·9960
·15	·09371	·03563	2·15	·84416	45·8899
·20	·12465	·06375	2·20	·85025	52·7294
·25	·15534	·10043	2·25	·85599	60·6805
·30	·18571	·14608	2·30	·86140	69·9410
·35	·21572	·20121	2·35	·86650	80·7466
·40	·24530	·26644	2·40	·87132	93·3785
·45	·27441	·34251	2·45	·87587	108·1734
·50	·30299	·43030	2·50	·88016	125·535
·55	·33099	·53083	2·55	·88422	145·946
·60	·35839	·64531	2·60	·88807	169·991
·65	·38513	·77509	2·65	·89171	198·369
·70	·41118	·92177	2·70	·89516	231·930
·75	·43651	1·08716	2·75	·89843	271·696
·80	·46110	1·27337	2·80	·90154	318·909
·85	·48493	1·48278	2·85	·90449	375·075
·90	·50797	1·71815	2·90	·90731	442·028
·95	·53022	1·98263	2·95	·90998	521·999
1·00	·55165	2·27983	3·00	·91254	617·713
1·05	·57228	2·61391	3·05	·91498	732·506
1·10	·59208	2·98961	3·10	·91730	870·463
1·15	·61108	3·41242	3·15	·91953	1036·599
1·20	·62926	3·88863	3·20	·92166	1237·088
1·25	·64665	4·42549	3·25	·92371	1479·538
1·30	·66324	5·03136	3·30	·92567	1773·344
1·35	·67906	5·71590	3·35	·92755	2130·136
1·40	·69412	6·49026	3·40	·92936	2564·332
1·45	·70844	7·36736	3·45	·93110	3093·849
1·50	·72203	8·36218	3·50	·93277	3740·988
1·55	·73493	9·49211	3·55	·93438	4533·572
1·60	·74715	10·77737	3·60	·93593	5506·376
1·65	·75871	12·24149	3·65	·93743	6702·955
1·70	·76965	13·91195	3·70	·93888	8177·972
1·75	·77999	15·82082	3·75	·94027	10,000·169
1·80	·78975	18·00564	3·80	·94162	12,256·169
1·85	·79896	20·51038	3·85	·94292	15,055·358
1·90	·80765	23·38668	3·90	·94418	18,536·141
1·95	·81584	26·69522	3·95	·94540	22,874·013
2·00	·82357	30·50747	4·00	·94658	28,291·951

A PRELIMINARY REPORT ON SOME BREEDING EXPERIMENTS WITH FOXGLOVES.

By ERNEST WARREN, D.Sc. (Lond.).

In 1914 in the garden of the writer there occurred among some ordinary foxgloves (*Digitalis gloxiniaeflora*) a specimen of the variety known as *monstrosa* in which there is a large, more or less regular, peloric or crown flower arising by the fusion of a variable number of ordinary flowers at the top of the axis. The idea arose that it would be of interest to ascertain whether this peloric character would blend in the offspring when the two forms of foxgloves were crossed, or whether, as would appear more likely, the character would be transmitted in its entirety or not at all.

In working at this particular character it was found that the shape, the spotting, and the general intensity of colouration of the ordinary zygomorphic flowers varied greatly, and accordingly a record has been made of these different characters in the first generation. The second generation is now being raised; but, as it will be some time before flowering takes place, a preliminary report on the results of the observation on the first generation will be of interest, since they indicate the general trend of the experiment.

I am much indebted to Dr Conrad Akerman for making most of the measurements and for ever-ready assistance in the experiment; to Mr A. W. Cullingworth, Mr W. G. Rump and Miss R. Meanwell for general help in the cultivation of the plants, mounting the pressed flowers, etc., and to Mr George Carter, Mr W. Bainbridge, Mr C. R. C. McDonald and Mr H. C. Burnup for growing some of the plants in their gardens, also to Mr J. F. Nicolson for allowing me to examine and take specimens of plants from his private grounds.

I. *Material.*

The parent plants were the following:

(1) Medium-purple crowned foxglove raised from seed from Erfurt, Germany = *A*.

(2) Very-pale-purple crowned foxglove from Mr George Carter's Nursery, Pietermaritzburg, raised from Erfurt seed = *C* (1).

(3) White ordinary foxglove (Carter) = *C* (2).

(4) Light-purple ordinary foxglove (Carter) = *C* (3).

(5) Medium-purple ordinary foxglove from Mr P. T. Badcock's garden, Hilton Rd = *B* (1).

(6) Pale-purple ordinary foxglove (Badock) = *B* (2).

(7) Medium-purple ordinary foxglove (Badock) = *B* (3).

(8) Dark-purple ordinary foxglove (Badock) = *B* (4).

(9) Dark-purple crowned foxglove from Mr J. F. Nicolson's garden, Boshoff Rd; seed from Messrs Dobbie, Edinburgh = *N* (1).

(10) Dark-purple creased lip ordinary foxglove (Nicolson) = *N* (2).

These plants were variously crossed or self-fertilized so that seed-capsules of some 36 different pairings were obtained. Unfortunately many of the families were completely killed soon after germination owing to scorching by the semi-tropical sun of Natal. There were ultimately obtained records of the flowering of 188 plants, the product of 19 families. In every case the contents of one capsule only were sown. Sowing was done in the middle of December, 1914, and flowering occurred in October and November of 1915. Most of the plants grew very luxuriantly and the flower-axes reached a height of 4 to 5 ft.

The following is a list of the families showing the parentage (seed-plant placed first) and the number of plants which flowered. Except where indicated the pollen was taken from the ordinary zygomorphic flowers:

I A	*A* (self-fertilized) ...	35	XI	*A* × *C* (3) ...	17
I	*C* (1) (self-fertilized)	7	XII	*C* (3) × *A** ...	1
II	*C* (1) × *B* (4) ...	8	XIV	*A* × *C* (2) ...	14
III	*B* (4) × *C* (1) ...	5	XV	*C* (2) × *A** ...	8
IV	*B* (4) (self-fertilized)	5	XV A	*A* × *C* (2) ...	7
V	*C* (1) × *B* (3) ...	23	XV B	*C* (2) × *A*† ...	1
VIII	*C* (1) × *C* (2) ...	10	XXIV	*A* × *B* (4) ...	13
IX	*C* (2) × *C* (1) ...	10	XXV	*B* (4) × *A*† ...	6
IX A	*C* (1) × *N* (2) ...	4	XXIX	*A* × *N* (1) ...	3
X	*C* (2) (self-fertilized)	11			

All the families except I A were grown in beds on a piece of land close to the Natal Museum. I A plants were raised in different private gardens of Pietermaritzburg.

II. *The Inheritance of certain Characters.*

The characters dealt with are:

(1) The possession of a crown or a terminal peloric flower at the top of the flower-axis.

(2) The presence of brown spots in place of dark-purple spots on the lower inside surface of the ordinary zygomorphic flower.

(3) The amount of spotting on the lower inside surface of the ordinary flower, expressed as the percentage of area of this surface covered by the spots.

* Pollen from crown flower.

† Pollen from terminal crown flower of side flower-axis.

(4) The intensity of the purple colouration over the general outer surface of the ordinary flower.

(5) The ratio of the maximum width of the corolla at the mouth to the total length of the corolla, expressed $\frac{\text{width}}{\text{length}} \times 1000$.

With reference to the spotting on the inside of the flower the percentage area covered by the spots was estimated by the help of a diagram consisting of a series of equal sized rectangles each of which was spotted to a known extent: 4 %, 8 %, 12 %, 16 %,.....64 %.

For estimating the intensity of the purple colouration over the general outer surface a colour scale was obtained in the following way. A very weak solution* of a mixture of aniline dyes was prepared which resembled the purple colour of the flowers. This solution was placed in upright rectangular glass jars of varying internal dimensions. With transmitted light the intensity of colour, of course, varied according to the depth of fluid. Jars of internal dimensions, measured from back to front, of 20 mm., 30 mm., 40 mm., 50 mm., 60 mm., 70 mm., 80 mm., 90 mm., 100 mm., 140 mm., 280 mm., were employed, and the colour of the solution, as viewed from the front of the jar with light coming from behind, was compared with the general colour of the flowers. Thus, if the colour of the flower was nearest, say, to the colour of the solution in a jar with a thickness of fluid of 70 mm. the colour of the plant was said to be 70. For a comparatively small range, as from 20 to 100 mm., the method appeared to work satisfactorily, but less reliance can be placed on the greater depths. In any case a scale of some definite physical significance is obtained.

The colour of the flowers is due to the presence of a purple cell-sap. In the case of the general colouration of the whole surface both the outside and the inside epidermal cells bear this coloured sap. In the spots, where the colouration is much more intense, the coloured cells are confined to the epidermis on the inside of the flower. In flowers which are white, with the exception of the deeply coloured spots, there may be some exceedingly faint traces of isolated streaks of purple on the inside of the flower, these are due to a slight colouration of the inside epidermal cells.

The flowers were measured with compasses and scale. The width was the maximum distance between the reflexed margins of the mouth, measured from right to left, and the length, measured along the adcauline surface, was the distance from the middle of the straightened-out margin of the mouth to the middle of the insertion-edge of the corolla.

1. *The peloric Character.*

The peloric flower at the top of the axis would appear to arise by the fusion of a varying number of the uppermost flowers and the concurrent entire suppression of the internodes between such flowers. Usually the apex of the main axis is un-

* Water 100 c.c., rubin 2·375 mg., gentian violet 0·125 mg. (Grübler).

affected, and after the peloric flower has withered it continues to grow through the centre of the crown and may produce a considerable number of zygomorphic flowers. On this out-growing axis a second and subsequently even a third peloric or crown flower may be produced. These are always less perfect than the first. In other plants the peloric flower is permanently the terminal flower, and the main axis ends in ovary and pistil.

In plant *A* the peloric flower consisted of four fused flowers, in plant *C* (1) of about eight flowers, and in both cases the main axis continued to grow on the withering of the crown. In *N* (1) the peloric flower was a regular deep cup consisting of only three fused flowers and the main axis terminated in an ovary.

In the case of side flower-shoots the axis seldom continues to grow, but generally terminates in a pistil. In plant *A* the terminal flower of the side shoot consisted of only two flowers which had fused laterally and the resulting structure was bilaterally symmetrical. In plant *C* (1) the side shoots terminated in a beautifully regular shallow cup consisting of three fused flowers.

In connection with the formation of the crown flower it is clear from the arrangement of the stamens, and the lobing and spotting of the corolla, that the structure arises as if the flowers had split along the middle line of the upper surface, spread out and fused with their neighbours along the split edges.

As an abnormality there occasionally occurred among the plants zygomorphic flowers completely split along the upper surface: they were otherwise quite normal flowers. Sometimes where split the edges gaped apart, and thus there is a tendency for the flowers to arise in a flat, leaf-like condition.

It may be supposed in fact that the complete suppression of certain internodes causes a definite number of flower-buds to fuse together in such a manner that when growth occurs the resulting structure has the appearance of being produced by the joining together of several zygomorphic flowers which have been cut open along the middle line of the upper surface and have been connected together to form a cup or shallow saucer.

It was soon found that imperfect crowns of different degrees of incompleteness could occur, and this fact raised the presumption that in the cross of a crowned plant and an ordinary plant the offspring would exhibit more or less intermediate characters.

It seemed quite hopeless to attempt to find a natural scale by means of which the intensity of the peloric character in different plants could be measured, and the following empirical grading was adopted.

(1) Plants in which the main axis carried a perfect crown of a variable number of flowers (3, 4, 8) was placed in the 100 % grade. On some few plants the corolla of the crown flowers was quite small and green, or even entirely absent, but the arrangement of the sepals indicated clearly that the peloric character was fully developed; such plants were also placed under the 100 % grade.

(2) Sometimes the main axis had its terminal portion spirally twisted in 1–2 turns, and in this region the flowers were excessively crowded owing to the great reduction in the length of the internodes. The flowers were very abnormal, and were usually split open and formed large, flat, coloured, petaloid structures which matured long before the lower normal flowers of the axis. The side shoots of such plants usually carried more or less perfect crowns. These plants were placed in the 75 % grade.

(3) Plants in which the main axis was ordinary and carried no crown, but the side flower-axes terminated in crowns, consisting of two or more fused flowers, were placed in the 50 % grade.

(4) Plants in which the main axis was markedly dwarfed, lumpy and curved, owing to the shortening of the internodes, but the flowers more or less normal, were placed in the 50 % grade.

(5) Plants in which the terminal portion of the main axis was somewhat curved, in which the upper internodes were reduced and of which the side shoots also showed such a tendency, were placed in the 25 % grade.

Spiral bending of the axis always occurs with the peloric condition when the crown consists of more than three flowers and the axis continues to grow through the crown. It is doubtless caused by the suppression of the internodes.

In the following table the results obtained in the first generation are summarized.

Parentage	Offspring						
	No.	Crowned or tendency for same					Not crowned
		100 %	75 %	50 %	25 %	Total crowned	
Ia. *A* (crowned 100 %) ♀ × ♂ (self) ...	33	33	0	0	0	33	0
I. *C* (1) (crowned 100 %) ♀ × ♂ (self) ...	7	3	0	4	0	7	0
X. *C* (2) (ordinary) ♀ × ♂ (self)	11	1	1	1	0	3	8
IV. *B* (4) (ordinary) ♀ × ♂ (self)	5	0	0	0	0	0	5
VIII. *C* (1) (crowned) ♀ × *C* (2) (ordinary) ♂	10	2	0	1	0	3	7
IX. *C* (2) (ordinary) ♀ × *C* (1) (crowned) ♂	10	5	0	1	0	6	4
II. *C* (1) (crowned) ♀ × *B* (4) (ordinary) ♂	8	0	0	0	0	0	8
III. *B* (4) (ordinary) ♀ × *C* (1) (crowned) ♂	5	0	0	0	0	0	5
V. *C* (1) (crowned) ♀ × *B* (3) (ordinary) ♂	23	0	0	0	0	0	23
XI. *A* (crowned) ♀ × *C* (3) (ordinary) ♂ ...	17	2	4	3	1	10	7
XII. *C* (3) (ordinary) ♀ × *A* (crowned) ♂ ...	1	0	1	0	0	1	0
XIV. *A* (crowned) ♀ × *C* (2) (ordinary) ♂ ...	14	7	2	0	0	9	5
XV. *C* (2) (ordinary) ♀ × *A* (crowned) ♂ ...	8	2	0	1	0	3	5
XVa. *A* (crowned) ♀ × *C* (2) (ordinary) ♂ ...	7	2	0	0	0	2	5
XVb. *C* (2) (ordinary) ♀ × *A* (crowned) ♂ ...	1	0	0	0	1	1	0
IXa. *C* (1) (crowned) ♀ × *N* (2) (ordinary) ♂	4	1	0	0	0	1	3
XXIX. *A* (crowned) ♀ × *N* (1) (crowned) ♂ ...	4	4	0	0	0	4	0
XXIV. *A* (crowned) ♀ × *B* (4) (ordinary) ♂	13	0	0	0	0	0	13
XXV. *B* (4) (ordinary) ♀ × *A* (crowned) ♂	6	0	0	0	0	0	6
Totals ...	...	...	...	...	...	83	104

It will be of interest to compare these figures with those that would be expected if the character behaved as a Mendelian unit. In the experimental results it will be noticed that all plants showing any tendency for a crown are grouped together as opposed to the plants exhibiting no such tendency.

To obtain the theoretical figures, and speaking in Mendelian terminology, it will be necessary to make certain assumptions as to the homozygous or heterozygous nature of the parent plants with regard to the presence or absence of a crown. The absence is dominant over the presence of a crown.

In the cases of parents *A*, *C* (1), *C* (2) and *B* (4) we have experimental evidence of the gametic nature of the plants. Reference to the above table will show that *A* and *C* (1) are pure recessives (families I A and I), *C* (2) is heterozygous (family X), and *B* (4) almost certainly homozygous dominant (family IV). For the other parents we assume that *B* (3) and *B* (4) are homozygous dominant, *N* (1) pure recessive, and *C* (3) and *N* (2) heterozygous.

With these assumptions, which are warranted by the behaviour of the parents in the various crossings, we can calculate the theoretical expectation for each family. The totals, to the nearest whole figure, are 83 plants crowned and 104 plants not crowned. The experimental result as shown above gives the same figures. In the light of other investigations this identity between the theoretical expectation and experimental result is to be regarded, of course, as unusual and accidental.

Of the 83 plants with a crown or a tendency for a crown the number in each grade is given below:

100 %	75 %	50 %	25 %	Total
62	8	11	2	83

In the various crossings of crowned parents and non-crowned parents there is thus a marked tendency for the character to be transmitted in its entirety or not at all. Notwithstanding this fact it nevertheless appears that the character can be diluted; for example in cross no. XI, *A* (crowned) ♀ × *C* (3) (ordinary) ♂, we have:

Crowned				Not crowned
100 %	75 %	50 %	25 %	
2	4	3	1	7

Thus, although the character appears to be capable of blending yet it is usually transmitted as a simple Mendelian unit.

2. *The Presence of Brown Spots.*

Among the various families there occurred plants with white corolla which possessed brown or greenish spots in place of the usual dark-purple spots. Such brown-spotted flowers only occurred when the corolla was white. If there was the faintest trace of purple on any part of the general surface of the corolla the spots were almost invariably purple. On the other hand the intensity of the colouration of the spots appeared to be in no way related to the intensity of the general colouration of the corolla, since some of the darkest coloured spots were found in flowers with an otherwise white corolla. In the terminology of the Mendelians it may be said that distinct factors control the general colouration of the corolla and the colour of the spots.

In this connection it is interesting to remember that the general colouration of the corolla is due to coloured sap in the cells of both the outer and inner epidermis of the flower, while the colouration of the spots arises through the colour in the inner epidermal cells only.

A microscopical examination of the brown spots revealed the presence of a granular brownish substance and of a great accumulation of typical starch grains. Such starch grains were few or absent in the surrounding epidermal cells; also they did not occur in the normal dark purple or crimson spots. The brown substance is almost certainly a decomposition product of anthocyanin, the normal colouring matter. Dr F. W. Bews, Professor of Botany, Natal University College, has suggested that possibly the starch also is to be regarded as a decomposition product of the anthocyanin: but the great abundance of the starch somewhat militates against this view.

The brown substance is insoluble in alcohol, ether, HCl (50 %) and potash (1 %).

With the naked eye there is a sharp discontinuity between white flowers with purple spots and white flowers with brown spots. Microscopical examination, however, shows that the discontinuity is not really so sharply defined. In many of the coloured cells of the purple spots traces of the brown substance may be detected, and at first it was thought possible that the removal of the purple colouring substance with alcohol would leave brown spots. This, however, was found not to be the case. Only rarely is the brown substance in sufficient quantity to mark out the spot on the removal of the anthocyanin. The point to notice is that brownish purple spots intermediate between the normal purple spots and the brown spots are only rarely found. Traces of an intermediate condition can be found microscopically, but there appears to be normally a gap between a small amount of decomposition product and total decomposition.

It will be remembered that there occurs a similar gap between ordinary foxgloves and crowned foxgloves; intermediate conditions are possible but only rarely occur.

If we assume that absence of decomposition (purple spots) is dominant and total decomposition (brown spots) recessive, and that the parents which produced white offspring were heterozygous dominants with respect to this character, we can compare the experimental result with the theoretical Mendelian expectation.

Parentage (Heterozygous dominants)	Offspring			
	Observation		Theoretical expectation	
	Purple spots	Brown spots	Purple spots	Brown spots
X. *C* (2) (self-fertilized)	9	2	8·25	2·75
Ia. *A* (self-fertilized) ...	26	7	24·75	8·25
XVa. *A* ♀ × *C* (2) ♂ ...	6	1	5·25	1·75
XVb. *C* (2) ♀ × *A* ♂ ...	0	1	0·75	0·25
XI. *A* ♀ × *C* (3) ♂ ...	12	5	12·75	4·25
XII. *C* (3) ♀ × *A* ♂ ...	1	0	0·75	0·25
XIV. *A* ♀ × *C* (2) ♂ ...	9	5	10·50	3·50
XV. *C* (2) ♀ × *A* ♂ ...	6	2	6·00	2·00
Totals ...	69	23	69·00	23·00

The assumption as to the heterozygous nature of the parents is warranted by the consistency which is shown when a supposed heterozygous dominant is crossed with an undoubted homozygous dominant. Thus we have:

Parentage	Offspring			
	Observation		Theoretical expectation	
	Purple	Brown	Purple	Brown
C (2) Heterozygous dominant ♀ × *C* (1) homozygous dominant ♂	10	0	10	0
C (1) Homozygous dominant ♀ × *C* (2) heterozygous dominant ♂	10	0	10	0
Totals	20	0	20	0

The fact that the observed result and the theoretical expectation in the above two tables should be identical may be regarded as somewhat accidental, but nevertheless the agreement is rather striking.

3. *The Amount of Spotting on the inner Surface of the Flower.*

By means of the diagram already referred to the percentage area, with respect to the lower portion of the inside surface of the flower, covered by the spots was estimated in six ordinary zygomorphic flowers in each plant. This character appeared

to exhibit no discontinuity in its inheritance. All intermediate conditions seemed to occur in the offspring; for example a parent with much spotting crossed with a parent with few spots tended to have offspring with a medium amount of spotting. It was quite impossible to sort out the parents or offspring into two or more groups of "much spotting," "little spotting," "medium spotting," etc. As far as can be judged from the material at hand the units of spotting, if such occur, are so small that the series is practically a continuous one.

The only satisfactory way of dealing with such a character which exhibits no discontinuity is the statistical method of Galton and Pearson. From the nature of the crossings it may not be always possible to deal statistically with the relationship of both male and female parent to the offspring. For example, if a single plant be crossed with the pollen of a dozen different plants, and families raised, there will be one female parent only, but 12 different male parents and twelve different mid-parents. Such a method of procedure is not free from objection, but it is the only course that is possible with the material at present available. In each plant the amount of spotting was determined in the bottom six flowers of the main axis, that is in the first six flowers which opened.

Another point to note is that some of the families were raised from seed obtained by self-fertilization. Now, the differences, if any, in the strength of inheritance in parthenogenesis, self-fertilization and cross-fertilization have not yet been fully investigated from an experimental point of view, and accordingly the heredity constants have been calculated both with the inclusion and the exclusion of the self-fertilized families.

Ordinary correlation tables have been made, utilizing the six flowers of each plant, and Prof. Pearson's constants have been calculated.

As an example the following table is given:

Spotting: Mid-Parent and Offspring (omitting self-fertilized Plants).

Mid-parent, percentage of spotting	54	96	189	144	105	91	45	31	12	6	Totals
8—11	34	36	36	2	—	—	—	—	—	—	108
12—15	20	43	72	39	7	—	—	—	—	—	181
16—19	—	3	53	55	47	42	28	24	4	2	258
20—23	—	—	—	4	5	2	1	—	—	—	12
24—27	—	9	27	39	18	13	7	—	—	—	113
28—31	—	5	1	5	28	29	2	2	4	2	78
32—35	—	—	—	—	—	5	7	5	4	2	23
Offspring, percentage of spotting	*0—3*	*4—7*	*8—11*	*12—15*	*16—19*	*20—23*	*24—27*	*28—31*	*32—35*	*36—39*	773

The general results may be summarized in the form of a table:

Relationship	No. of mid-parents	No. of off-spring	No. of flowers	Standard deviation of mid-parent	Standard deviation of offspring	Coefficient of correlation
Mid-parent and offspring (including self-fertilized families)	15	176	1027	10·509	8·500	·563
Mid-parent and offspring (excluding self-fertilized families)	11	127	773	6·610	7·790	·545
Male parent and offspring (including self-fertilized families)	15	176	1027	16·733	8·595	·431
Male parent and offspring (excluding self-fertilized families)	11	127	773	15·249	7·790	·320

With the small number of parents available the constants are bound to be erratic, and the results can only be regarded as giving a rough indication of the strength of inheritance. The general tendency is for a low parental correlation: the mean of the two paternal correlations is ·38. The average of some 52 correlation coefficients of parental heredity obtained from a variety of different animal species with various characters has been given by Prof. Karl Pearson as ·45, while the mean of the parental coefficients for a series of characters in the Shirley Poppy was ·33.

4. *General Colouration of Corolla.*

We have seen that the general colouration of the corolla is due to coloured sap in the epidermal cells of both the inside and outside of the corolla. The intensity of this colouration was estimated, as already described, by a colour-scale obtained by viewing by transmitted light varying depths of a standard tinted solution. There is discontinuity in the colour of the flowers of the plants. The flowers can be divided into (1) purple and (2) not purple (white). For this subdivision a purple flower must be defined as one in which the general surface of the corolla is coloured. The colour may be quite pale or very dark. A white flower is one in which the general surface is white, but there may be a few extremely faint blushes of purple on the corolla, especially on the inner surface.

Such definitions may seem empirical and unsatisfactory, but nevertheless it was found in practice to work quite easily owing to the fact that exceedingly faint *general* colouration of the whole corolla did not occur. There was a clear gap in the series between faintly "purple flowers" and the "white flowers." In the whole series the palest purple flower was represented by a depth of 15 mm. of coloured fluid and there was only one such plant.

In the accompanying table the families are arranged in the order of the mid-parental colour—the mean of the colours of the male and female parents.

| Parentage | | Mid-parental colour | Offspring: Purple (Uniform colouration of outer surface) | | |

By reference to the horizontal line of totals at the bottom of the table it will be seen that among the purple offspring there are none under the first three units of the colour scale, 0–4, 5–9, 10–14. There would also appear to be discontinuity at the other end of the scale, but it is very doubtful as to how far reliance can be placed on the colour-scale where the depth of the fluid is considerable.

Taking the families altogether there were 139 purple plants and 41 white. The Mendelian expectation may be calculated for each family on making the following assumptions: purple colour dominant to white; $C(2)$ pure recessive; A, $C(1)$ and $C(3)$ heterozygous dominants; $B(3)$, $B(4)$, $N(1)$ and $N(2)$ homozygous dominants.

Justification for these assumptions is given by the consistency with which the different parents act in different pairings. The sum totals of the calculated expectations for all the families are 131 purple and 49 white. It will be seen that these figures are in very fair agreement with the experimental result which is 139 purple and 41 white. This may be regarded as a typical Mendelian result.

A point of interest is to ascertain as to how far the various intensities of the colouration among the purple plants are inherited. It is possible that some observers would regard the different intensities of the purple colouration in a family as representing mere fluctuating variations which could not be inherited. According to the pure-line theory the different intensities of purple colouration occurring within the limits of a family resulting from self-fertilization cannot be inherited. It will be possible to test this theory in the generation of plants now being raised, but the present material cannot give a definite reply to the question.

An inspection of the above table (p. 313) will show that as we pass to the higher mid-parental colours there is a *gradual* rise in the colouration of the families. This implies that the various shades of purple are not distinct types, but that they can blend perfectly with one another.

The fact that in closely similar matings the families raised show a regular progressive rise in the intensity of colouration with the rise in the mid-parental colouration does not favour the expectation that any support for the pure-line theory will be forthcoming from the present investigation.

It is desired to find the correlation with respect to the intensity of colour between the purple parents and the purple offspring. For this purpose, in order to have strictly homogeneous material, the parents should be homozygous dominants. The material will not permit such a calculation. The purple plants of the different families include both homozygous dominants and heterozygous dominants. Now the homozygous dominants are found to be darker in colour than the heterozygous dominants, and so in any family consisting of an equal number of heterozygous

and homozygous dominants we may approximately divide the individuals into the two groups by regarding the darker half as homozygous and the lighter half as heterozygous dominant. In this way we can form a correlation table between the parents and the heterozygous or the homozygous offspring.

Using the symbols introduced by Prof. Bateson, namely *RR* homozygous recessive, *DR* heterozygous dominant, *DD* homozygous dominant, we have, on crossing individuals of the different gametic constitutions, the following theoretical results:

RR × *DR* = 1 *DR* (light purple) + 1 *RR* (white),

DR × *DR* = 1 *DD* (dark purple) + 2 *DR* (light purple) + *RR* (white),

DR × *DD* = 1 *DD* (dark purple) + 1 *DR* (light purple).

In calculating the correlation it is advisable to use only parents and offspring of similar gametic constitution; thus, *DR* parents with *DR* offspring, or *DD* parents and *DD* offspring. *RR* parents and *RR* offspring being white are excluded.

To accomplish this it is necessary in any given family, obtained by crossing together *RR*, *DR* and *DD* parents, to sort out the purple offspring into *DR* and *DD* individuals. To do this with complete certainty it would be necessary to self-fertilize each individual and obtain families. The labour involved is too great to be undertaken lightly. Owing to the fact that *DR* offspring are paler than *DD* offspring we may approximately divide the families into the two groups of individuals by taking the darker half (in the case of *DR* and *DD* parentage) or the darker one-third (in the case of *DR* and *DR* parentage) of the plants as being *DD* individuals in constitution and the remainder as being *DR* individuals.

Thus for example:

Parentage	Family under Colour-Scale (see preceding table)
VIII. *C* (1) × *C* (2) = *DR* × *RR*	1, 2, 4 (*DR*), *RR* (excluded from table)
I. *C* (1) × *C* (1) = *DR* × *DR*	1, 0, 1, 1, 2, 1 ($\frac{1}{4}$ *DD* and $\frac{3}{4}$ *DR*) = 1, 0, 1 *DD* + 1, 2, 1 *DR*
IXA. *C* (1) × *N* (2) = *DR* × *DD*	1, 0, 3 ($\frac{1}{2}$ *DD* and $\frac{1}{2}$ *DR*) = 1, 0, 1 *DD* + 2 *DR*

In this way a correlation table can be made with fair accuracy between *DR* parent and *DR* offspring. The paucity of the material, however, prevents much reliance being placed on the actual figures obtained. At most the figures can give only a rough indication of the strength of inheritance.

When a heterozygous purple plant is crossed with a white plant (recessive) both purple and white offspring are produced. The coloured offspring, however, tend to be paler than the coloured parent. Thus the colour of the coloured

DR Female Parent and DR Offspring.

Female parent, general colouration	2	6	8	8	3	3	12	5	5	12	8	2	1	1	Totals
30—34	—	4	3	5	3	2	8	4	—	—	—	—	—	—	29
35—39	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
40—44	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
45—49	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
50—54	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1
55—59	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
60—64	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
65—69	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
70—74	2	2	5	3	0	1	4	1	5	11	8	2	1	1	46
Offspring, general colouration	*20—24*	*25—29*	*30—34*	*35—39*	*40—44*	*45—49*	*50—54*	*55—59*	*60—64*	*65—69*	*70—74*	*75—79*	*80—84*	*85—89*	76

DR Male Parent and DR Offspring.

Male parent, general colouration	1	2	3	6	5	2	1	3	1	5	6	7	1	1	Totals
30—34	—	—	2	2	5	1	0	0	1	0	0	0	1	—	12
35—39	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
40—44	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
45—49	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
50—54	—	1	0	4	0	0	0	1	0	1	1	—	—	—	8
55—59	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
60—64	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
65—69	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
70—74	1	1	1	0	0	1	1	2	0	4	5	7	0	1	24
Offspring, general colouration	*15—19*	*20—24*	*25—29*	*30—34*	*35—39*	*40—44*	*45—49*	*50—54*	*55—59*	*60—64*	*65—69*	*70—74*	*75—79*	*80—84*	44

parent has been diluted by crossing with the colourless parent. Since such blending occurs it will be of interest to find the correlation between the mid-parental colour and the colour of the *DR* offspring. The *DD* and *DR* offspring were separated from one another by the method above described.

Mid-Parent and DR Offspring (including self-fertilized Families).

Mid-parent, general colouration	1	3	9	9	11	4	3	10	6	9	12	9	3	2	1	Totals
15—19	—	—	6	3	3	—	—	—	—	—	—	—	—	—	—	12
20—24	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
25—29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
30—34	—	—	—	1	2	1	—	—	—	—	—	—	—	—	—	4
35—39	1	2	3	1	3	1	0	1	0	3	5	1	—	—	—	21
40—44	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
45—49	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
50—54	—	—	—	—	—	2	2	4	4	2	—	—	—	—	—	14
55—59	—	—	—	—	3	0	0	2	1	0	0	0	1	—	—	7
60—64	—	1	0	4	0	0	0	1	0	1	2	—	—	—	—	9
65—69	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
70—74	—	—	—	—	—	—	1	2	0	2	3	6	0	0	1	15
75—79	—	—	—	—	—	—	—	—	1	1	2	2	2	2	—	10
Offspring, general colouration	*15—19*	*20—24*	*25—29*	*30—34*	*35—39*	*40—44*	*45—49*	*50—54*	*55—59*	*60—64*	*65—69*	*70—74*	*75—79*	*80—84*	*85—89*	92

The general results may be summarized as follows:

Relationship	No. of mid-parents or parents	No. of *DR* offspring	Standard deviation of parents	Standard deviation of *DR* offspring	Coefficient of correlation
Mid-parent colour and colour of *DR* offspring (including self-fertilized families)	17	92	19·280	17·520	·675
Mid-parent colour and colour of *DR* offspring (excluding self-fertilized families)	15	74	18·514	17·800	·587
Male parent (*RD*) colour and colour of *DR* offspring (including self-fertilized families)	8	44	17·249	18·336	·471
Female parent (*DR*) colour and colour of *DR* offspring (including self-fertilized families)	12	76	19·351	16·563	·415

We see from the above that the strength of inheritance, with respect to the intensity of colouration, between individuals of similar gametic constitution follows a similar statistical law to that exhibited by characters where discontinuity cannot be detected, where complete blending occurs and no trace of segregation can be found.

It might have been anticipated by some that the varying intensities of the general colouration among individuals of similar gametic constitution were casual, fluctuating variations which could not be inherited. The above results point to the view that small variations of this nature are inheritable, and consequently they can be of importance in the evolution of species.

5. *The Ratio of the Breadth to the Length of the Corolla.*

The parent plants differed markedly in the relative width of the corolla. *C* (1), *C* (2) and *N* (1) were wide, *B* (1), *B* (3) and *B* (4) were narrow, and the remainder were of medium width. As in the case of the amount of spotting of the corolla, no distinct discontinuity in the variation of the character could be noticed either in the parents or offspring. As far as could be judged the variation was a continuous one, or one with such small steps as practically to be equivalent to the same.

The following tables of correlation are given as records:

Ratio, Mid-parent and Offspring (excluding self-fertilized Families).

Mid-parent. Breadth/Length 1000	3	4	11	28	39	47	77	80	102	103	80	61	45	30	31	9	7	6	7	3	1	Totals
503—516	3	0	3	14	17	11	16	14	15	11	7	3	—	—	—	—	—	—	—	—	—	114
517—530	—	2	3	3	0	1	0	2	1	—	—	—	—	—	—	—	—	—	—	—	—	12
531—544	—	—	—	1	3	5	10	10	23	24	11	14	2	3	2	—	—	—	—	—	—	108
545—558	—	2	5	10	19	29	44	47	54	53	51	30	25	10	9	4	1	2	1	—	—	396
559—572	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
573—586	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
587—600	—	—	—	—	—	1	7	5	5	10	10	9	16	15	18	4	6	4	6	3	1	120
601—614	—	—	—	—	—	—	—	2	4	5	1	5	2	2	2	1	—	—	—	—	—	24
Offspring. Breadth/Length 1000	*419—432*	*433—446*	*447—460*	*461—474*	*475—488*	*489—502*	*503—516*	*517—530*	*531—544*	*545—558*	*559—572*	*573—586*	*587—600*	*601—614*	*615—628*	*629—642*	*643—656*	*657—670*	*671—684*	*685—698*	*699—712*	774

Ratio, Male parent and Offspring (including self-fertilized Families).

Male parent. Breadth/Length 1000	1	9	27	58	86	121	145	164	147	109	74	28	9	16	5	1	Totals
480—499	—	3	7	20	32	18	31	19	15	11	—	—	—	—	—	—	156
500—519	—	—	1	2	14	24	17	34	24	12	8	1	0	1	—	—	138
520—539	1	4	15	25	23	30	48	53	48	29	13	5	2	2	—	—	298
540—559	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
560—579	—	2	4	8	13	36	34	31	35	25	28	18	6	10	2	—	252
580—599	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
600—619	—	—	—	3	4	13	15	27	25	32	25	4	1	3	3	1	156
Offspring. Breadth/Length 1000	*400—419*	*420—439*	*440—459*	*460—479*	*480—499*	*500—519*	*520—539*	*540—559*	*560—579*	*580—599*	*600—619*	*620—639*	*640—659*	*660—679*	*680—699*	*700—719*	1000

Relationship	No. of parents	No. of off-spring	No. of flowers	Standard deviation of parents	Standard deviation of offspring	Coefficient of correlation
Mid-parent and offspring (including self-fertilized families)	15	176	1000	29·626	49·220	·554
Mid-parent and offspring (excluding self-fertilized families)	11	127	774	25·886	47·164	·509
Male parent and offspring (including self-fertilized families)	15	176	1000	38·783	49·236	·341
Male parent and offspring (excluding self-fertilized families)	11	127	774	38·898	47·358	·300

The parental correlation is thus low as in the case of the area covered by spots. Such a condition increases the probable error of the numerical results, and many more parents would be necessary in order to obtain more reliable figures. Nevertheless it may be noted that the statistical results obtained with the various characters are very fairly consistent with one another and the parental inheritance of the characters investigated tends to be somewhat low.

III. *The Variability of the Race and of the Families.*

According to the pure-line theory the variability within a family consisting of individuals of similar gametic constitution .nd arising by self-fertilization of the parent should be small, supposing that no new mutation should arise, and it is of such a nature that it is incapable of being transmitted by inheritance. Selection within such a family would not be effective. In other words, families obtained by self-fertilizing individuals at the two ends of the range of variation would exhibit the same mean. The material at present to hand will not throw direct light on the question, but indirectly it lends no support to the theory.

The comparative variabilities of the race and of the individual families are given in the table on p. 320. The colour of the different flowers on an axis was found to be essentially uniform; but in the two other characters there was some variability among the flowers on the same axis. Therefore in these two characters (the area covered by spots, and the ratio of the width to the length of the corolla) the mean of the six basal flowers of the axis was taken as expressive of the nature of the plant.

Thus the mean variability of a family is 67 % of the variability of the whole race. Owing to the fact that the majority of these families arose through cross-fertilization this large family variability is not a proof against the pure-line theory. It may be stated here that with the four self-fertilized families raised there was some tendency for a reduction in the variability, but nevertheless it remained very considerable.

The average percentage variability of the self-fertilized families is 50 % of the variability of the race. This is to be compared with 67 % for cross-fertilized

families. The number of the families is, however, too few for drawing any absolute conclusions. With such a high variability in these families it would appear improbable that the families obtained by self-fertilizing the individuals at the extremes of the range would both exhibit the same mean. It may be added that in the parthenogenetic aphis (*Hyalopterus*) it has been shown that the variability of the family amounted to 60 % of that of the race.

Character	No. of individuals in generation	Standard deviation (S.D.) of generation	No. of families with six or more individuals	No. of individuals	Mean standard deviation (S.D.) of the families	$\frac{\text{S.D. fam.}}{\text{S.D. gen.}} \times 100$
Intensity of general colouration (*DR* individuals)	90	3·490	8	69	2·349	67
Ratio $\frac{\text{Breadth}}{\text{Length}}$ corolla	172	3·324	13	154	2·414	73
Spotting	178	1·816	13	160	1·000	61
				Mean of percentages ...		67

It must be remembered that Johanessen's experiments have been shown by Karl Pearson to be inconclusive with reference to the pure-line theory. The size of the different seeds produced by any given individual plant varies greatly, and there is no inherent reason to suppose that the offspring obtained from the small seeds and large seeds taken from the same plant would exhibit any difference in the size of their seeds. It might reasonably be supposed that a small seed and a large seed from the same plant would both inherit the average character of the parent irrespective of their actual size. One might as well expect that the plants obtained by budding from a small begonia leaf would have smaller leaves than those obtained from a larger leaf of the same plant.

IV. *Fraternal Correlation.*

The likeness of brothers to one another has been investigated, and the relationship was studied after the method adopted by Prof. Pearson. He takes each individual of a family and compares its deviation from the mean with that of every other member of the family. These combinations can be plotted out in a correlation table in a similar manner to the relationship of offspring and parent. The coefficient of correlation for all possible pairs of brethren will be a measure of their resemblance, just as the standard deviation is a measure of their dissimilarity.

The fraternal correlation was calculated for (1) the intensity of the general colouration of the purple flowers, (2) the area of the spots, (3) the ratio of the width to the length of the corolla.

For the intensity of the general colouration only offspring having a similar gametic constitution were taken. Heterozygous individuals, or those which are

supposed to produce two kinds of gametes, were used. With regard to the ratio and the area covered by the spots the nature of the individual was determined by taking the mean of the varying values obtained from six different flowers from the flowering axis. This procedure was unnecessary in the case of the colour, as the individual flowers on the same axis did not differ from one another perceptibly.

As a record the fraternal correlation table for spotting is herewith given:

Percentage spotting, 1st brother	281	378	425	596	300	168	147	21	16	4	Totals
0—3	64	98	70	47	2	—	—	—	—	—	281
4—7	98	138	73	65	4	—	—	—	—	—	378
8—11	70	73	124	91	34	20	8	1	4	—	425
12—15	47	65	91	178	107	53	48	5	2	—	596
16—19	2	4	34	107	64	49	30	8	2	—	300
20—23	—	—	20	53	49	20	19	4	2	1	168
24—27	—	—	8	48	30	19	36	1	4	1	147
28—31	—	—	1	5	8	4	1	0	1	1	21
32—35	—	—	4	2	2	2	4	1	0	1	16
36—39	—	—	—	—	—	1	1	1	1	—	4
Percentage of spotting, 2nd brother	*0—3*	*4—7*	*8—11*	*12—15*	*16—19*	*20—23*	*24—27*	*28—31*	*32—35*	*36—39*	2336

The comparative results obtained for parental correlation and fraternal correlation are shown in the following table:

Character	Parental			Fraternal	
	No. of families	No. of offspring	Correlation	No. of pairs of brothers	Correlation
Intensity of purple colouration of corolla	14	98	·47	318	·52
Area of spots	19	178	·53	1168	·61
Ratio $\frac{\text{Width}}{\text{Length}}$ corolla ...	19	170	·37	1032	·29
Mean of correlations ...			·46	—	·47

The parental correlations given above differ somewhat from those given in an earlier part of the paper owing to the fact that the mean of the character, as it occurred in the six flowers, was taken instead of using the individual flowers of the plant.

The means of the coefficients of the three characters are ·46 and ·47 for the parental and fraternal correlation respectively. These results are not very divergent from those obtained by Prof. Pearson from very various sources; he gives the average parental correlation as about ·48.

V. *Summary.*

The data at present available were derived from crossing in various ways 10 cultivated foxglove plants with different characteristics, namely: crowned or peloric, not crowned, purple of different intensities, white, relatively wide and relatively narrow corolla, etc. There were 19 families; each family being raised from the seed of a single capsule. Altogether 188 offspring which flowered were obtained.

The nature of the inheritance of the following characters was studied: (1) peloric or crown character, (2) the colour of the spots, (3) the relative area covered by the spots, (4) the colour of the corolla and the degree of intensity of the purple colouration of the general surface, (5) the ratio of the width to the length of the corolla.

The numerical results obtained are given below:

Character	Mendelian Inheritance (parent and offspring)				Statistical Relationship (parent and offspring)		
	Observed		Theoretical Expectation		Coefficient of Correlation		
					Foxgloves		Mean of coefficients from various sources
	No. with character present	No. with character absent	No. with character present	No. with character absent	Including self-fertilized families	Excluding self-fertilized families	
Crown	83	104	83	104	—	—	
Brown spots	23	69	23	69	—	—	
Percentage area covered by spots	—	—	—	—	·43	·32	
General purple colouration	41	139	49	131	·47	·41	·45
Ratio of breadth to length of corolla	—	—	—	—	·34	·30	
Totals	147	312	155	304	·41	·34	
					·38		

(1) The peloric character may be regarded as arising by the suppression of certain internodes of the flower-axis and the concurrent fusion of the flower-buds resulting in a more or less regular cup or saucer-shaped flower at the top of the

axis, which matures before the ordinary zygomorphic flowers. This variety is known as *monstrosa*.

When a peloric plant is crossed with a non-peloric plant the offspring are generally either completely peloric or completely non-peloric. There is no marked tendency for the offspring to be intermediate in character. Notwithstanding this fact the character is capable of dilution, since in the case of one family arising from such a cross nearly all of the offspring were more or less intermediate in nature. Certain of the internodes were much reduced, but not entirely suppressed, and the flowers involved arose in the form of petaloid blades which matured before the lower normal flowers, as in the case of a typical crowned plant.

The gametic nature of the parents, as to whether they were pure or impure in the Mendelian sense with reference to the peloric character, could be judged either by raising families obtained by self-fertilization or by their action in the various crosses that were made. Families derived from self-fertilization from four parents were successfully raised, and in the case of the remaining parents the marked consistency in their behaviour in the different crosses indicated clearly as to whether they were homozygous or heterozygous.

The non-peloric condition was dominant.

On dividing the offspring into peloric plants (including those which showed any tendency towards a peloric condition) and non-peloric plants, the numbers were 83 peloric and 104 non-peloric. Calculating the Mendelian expectation for each family and adding the results the figures obtained were identically the same.

(2) The results of reciprocal crosses appeared to be the same; that is the families obtained from ♀ $A \times ♂ B$ did not differ in any constant manner from those derived from ♀ $B \times ♂ A$.

(3) The results obtained by using pollen from the crown flower, the ordinary zygomorphic flower and of flowers with abnormally split open corolla did not appear to differ from one another in the least.

(4) The colour of the seeds is very definitely related to the colour of the flowers of the seed-plant. Plants with white flowers had very pale buff-coloured seeds, those with light purple corollas had light brown seeds, while those with dark purple corollas had very dark brown seeds. As might be expected, a plant with white flowers crossed with pollen from a plant with dark purple flowers produced pale coloured seeds, since the coloured testa of the seed is formed by the seed-plant and is not a result of fertilization.

This observation emphasizes the fact that great caution is necessary in regarding characters as being independent of one another. It is often stated that an organism may be pure bred in one character and not in another; but probably this is true only in a very limited sense. De Vries holds that a change in any one character involves some change in the constitution of the organism as a whole.

(5) In plants in which the general internal and external surfaces of the corolla are white, the spots which occur may be purple or brown. Sometimes spots were nearly absent and the corolla appeared to be practically pure white, but when such was the case some sign of brown spots could be found on some few of the flowers. An obviously intermediate condition between purple spots and brown spots was rare, and judged by ordinary inspection the spots were either purple *or* brown, seldom brownish purple. The brown colouring matter may be regarded as a decomposition product of the purple anthocyanin. In plants in which the corolla was coloured purple over the general surface the spots were never entirely brown. Thus it would appear from the present observations that the causes which lead to the total decomposition of the anthocyanin in the purple spots of otherwise white flowers are never wholly effective in flowers with purple corolla. Accordingly although there is some independence between the two characters, the colouration of the spots and the colouration of the general surface of the corolla, yet nevertheless there seems to be a certain relationship between the two, since the spots were never found to be completely brown unless the general surface of the corolla was white. A feature of unknown significance may be mentioned, the cells of the spots containing the brown colouring matter were found to be densely crowded with typical starch grains, while the cells of the purple spots containing the anthocyanin in solution in the cell-sap contained little or no starch.

Purple spots were dominant and brown spots recessive.

The observed results in the different families totalled 69 plants with purple spots and 23 with brown spots. The Mendelian expectation calculated for each family and added together yielded exactly the same figures. Since completely brown spots were never found in coloured flowers, only those families in which plants with white flowers occurred were included in this calculation.

(6) With regard to the general colouration of the corolla it was found that some of the parents were heterozygous and others homozygous. The results of the crossings were distinctly Mendelian in character. Purple was dominant and white recessive. There were 41 white and 139 purple offspring; the theoretical expectation, calculated for each family and added together, was 49 white and 131 purple.

A point of considerable interest was noticed, namely that in dealing with parents and offspring of similar gametic constitution (i.e. heterozygous and homozygous dominant) the inheritance of the intensity of colouration followed the usual statistical laws. A light purple plant crossed with a dark purple plant might give some perfectly white offspring, but those offspring that were coloured, if of the same gametic character as the parent, tended to be intermediate in shade between the two parents. Thus the intensity of colouration is not a mere fluctuating uninheritable character, but its inheritance follows the usual laws found by statisticians to hold in the case of characters where a Mendelian relationship cannot be detected. The parental coefficient of correlation between heterozygous

dominant parents and heterozygous dominant offspring including self-fertilized families was ·47 for male parent and ·41 for female parent. These figures are not far removed from Prof. Pearson's mean coefficient ·45.

(7) The remaining two characters dealt with, viz. the percentage area covered by the spots and the relative width of the corolla, exhibited no discontinuity in their inheritance, and consequently a Mendelian relationship could not be detected. The parental coefficients of correlation for the spotting, including and excluding the self-fertilized families, were ·43 and ·32 respectively, and for the width ·34 and ·30. The mean of all four coefficients is ·35 which has to be compared with Prof. Karl Pearson's mean coefficient of ·45 derived from various sources. Owing to the fewness in the number of parents the probable errors of the foxglove coefficients of correlation are large, but nevertheless there appears to be a distinct tendency for the parental correlation to be low. Similarly Prof. Karl Pearson found parental inheritance to be low in the Shirley Poppy: the mean value being ·33.

(8) The mean of the seven mid-parental correlations, calculated for the crown character, the spots, the general colouration and width of the corolla, is ·57 and the mean of the six parental correlations is ·38.

(9) The experiment at the present stage cannot throw any direct light on the pure-line theory. The variability which occurred among cross-fertilized families amounted to 67 % of the variability of the race, and among several self-fertilized families it was 50 %. With such a high variability it would appear to be unlikely that the families, raised by self-fertilizing the two brethren at the two ends of the range of variation of the families, would exhibit the same mean.

(10) The resemblance of the individuals of a family to one another with reference to several characters was calculated, and the mean of these fraternal correlations was found to be ·47. Prof. Karl Pearson gives a mean value of ·5 or a little more for the fraternal correlation of a series of diverse characters.

VI. *Theoretical Conclusions.*

We thus see that among the characters examined we find typical Mendelian and typical non-Mendelian results, and the relationship between the two types of inheritance is by no means clear. It has been said that Mendelian inheritance occurs in the case of characters which do not mix, but this view is not warranted by the present results. For example, the peloric character can be diluted by crossing with the ordinary type, but such dilution does not usually take place; also, the general purple colouration of the corolla is diluted when a dark parent is crossed with a pale parent; but, nevertheless, a very pale general colouration is exceedingly rare, and the flower is as a rule either distinctly purple (although perhaps rather pale) or white. Thus we have discontinuity even when characters are capable of dilution.

From the experimental data which have been accumulated during the last decade there is no doubt that segregation of characters may occur in crossing

hybrids, and by defining the unit-character in a suitable manner the familiar ratios so well known to Mendelians do appear in the case of certain characters. The above expression "defining the unit-character in a suitable manner" is well illustrated in the case of the general colouration of the foxglove flowers. Provided we define a "purple flower" as meaning a flower in which the corolla is more or less uniformly tinted all over we obtain a simple Mendelian relationship; but many of the white flowers, on being closely scrutinized, were seen to possess an excessively faint tinge of purple over small isolated areas, the remainder of the corolla being dead white. If these plants had been included under the category of "purple flowers" no Mendelian relationship would be apparent. There is, however, a certain justification for excluding such from the category of "purple flowers," since there is a distinct gap in the series between the flowers which are tinted faintly purple all over and the white flowers with an extremely slight blush of purple over small irregularly placed areas.

A similar relation occurs in connection with the brown spots. Provided the spots are examined with the naked eye they are very generally either brown or purple; brownish purple spots were seldom observed, and a simple Mendelian relationship occurs, brown spots being recessive. If, however, the purple spots are examined under the microscope the distinction between the two kinds of spots is seen to be not so sharp, since a certain amount of decomposition product may be present, although not as a general rule in sufficient quantity to give a spot a brownish purple appearance to the naked eye. Here, again, we have a distinct gap in the series; it occurs between a small amount of decomposition and total decomposition. A strict Mendelian might hold that in the first case the slight tinge of purple occurring in the white flowers was a character distinct from the purple colouration of the general surface of the corolla, and was controlled by a different determinant or group of determinants; but such a supposition could scarcely be applied to explain the occurrence of the gap between the small amount of decomposition and the total decomposition of the anthocyanin of the spots. By presupposing the existence of many factors controlling a character and the linkage of factors it may be possible to express in Mendelian terms almost any experimental result that may be obtained, but it must be confessed that there is an artificiality about the process which does not inspire confidence in the interpretation.

With regard to the peloric character, in order to obtain a simple Mendelian relationship, it is necessary to include in the peloric category all plants which exhibited any distinct tendency towards the peloric condition. There is a gap in the series between flower-axes which exhibit some shortening of the internodes of the upper flowers and a marked shortening resulting in a distinct abnormality; and it is this gap in the series which gives the clue as to where the line of division should be drawn between peloric plants and non-peloric plants.

The question arises as to how far a so-called unit-character is capable of change. In the course of evolution any given character must of necessity have arisen in some

way from some other character, and according to de Vries it arose by a sudden mutation. It is clear, however, that the somatic nature of an individual tends to reflect its gametic constitution, and obversely any change in the somatic nature of an individual tends to imply a change in the determinants of the germ-cells; and therefore the factor or determinant, say, of the general colouration of the corolla in a pale purple heterozygous dominant foxglove differs to some extent from that in a darker purple heterozygous plant: and the offspring of these two plants, if crossed with the same pollen, and bred under the same environment (in its widest sense) would not be the same. I have deduced some evidence in this investigation to show that the relationship of parents and offspring with respect to the fluctuations in the intensity of expression of a Mendelian character is similar to that of a non-Mendelian character provided the parents and offspring are of the same class, i.e. all heterozygous or all homozygous. It follows from this that a slight variation in the nature of the factor in the parent is accompanied by a slight somatic variation in the offspring and will be subjected to natural selection.

It appears to be premature to attempt to visualize these complicated phenomena in the nuclear behaviour of the sexual cells, although Morgan and others* have made ingenious attempts at so doing. In any such attempt it seems necessary to assume the existence of factors, determinants, plasms or something, no matter what it is called, which bears the heredity influence. Speaking in these mechanical terms it may be suggested that characters which exhibit no discontinuity in their inheritance, i.e. show no Mendelian relationships, are transmitted by a determinant or a system of determinants uniformly distributed through the chromosomes, and perhaps also through the cytoplasm of the germinal cells; while those characters which do exhibit Mendelian relationships depend on determinants which are localized in the chromosomes only, and possibly in definite places in the chromosomes. Morgan has recently referred to this last conception as the linear arrangement of factors in the chromosome.

In both cases, whether localized or not, the determinants controlling a particular character are variable in nature and are therefore subject to gradual modification by the natural selection of the individuals which bear the genital cells.

Mendelian inheritance in its original simple form, as it sometimes appears in the crossing of varieties, would seem to be, so to speak, an incidental phenomenon arising through the nuclear changes and the localization of the determinants, and it is open to question whether it has had any marked influence in the evolution of species. It is conceivable that evolution has taken place in spite of, rather than by the aid of, such Mendelian inheritance. The hereditary influence of the parent varies slightly through changes from unknown causes in the nature of the determinants, and the small resulting somatic variations in the offspring would appear to constitute the chief means by which evolution may slowly proceed and adaptation to the environment can be effected.

* Morgan, T. H. and others, *The Mechanism of Mendelian Heredity*, New York, 1915.

ON THE DISTRIBUTION OF THE CORRELATION COEFFICIENT IN SMALL SAMPLES. APPENDIX II TO THE PAPERS OF "STUDENT" AND R. A. FISHER.

A COOPERATIVE STUDY

By H. E. SOPER, A. W. YOUNG, B. M. CAVE, A. LEE and K. PEARSON

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(1) *Introductory.* In a paper of 1908* "Student" dealt experimentally with the distribution of the correlation coefficient of small samples, and gave empirical curves—in particular for the case of zero correlation in the sampled population—which have proved remarkably exact. The problem was next considered in 1913 by H. E. Soper† who obtained the mean correlation and the standard deviation of the distribution of correlations to second approximations. Of the

* *Biometrika*, Vol. VI. p. 302 *et seq.*

† *Biometrika*, Vol. IX. p. 91 *et seq.*

formulae he gives for $\bar{r}$ and σ_r of the distribution of the correlation r in samples of n from a population of correlation ρ, we have found in practice the most exact are*

$$\bar{r} = \rho\left\{1 - \frac{1}{2n}(1-\rho^2) - \frac{3}{8n^2}(1-\rho^2)(1+3\rho^2)\right\} \quad \text{.....(i)}$$

and

$$\sigma_r^2 = \frac{(1-\rho^2)^2}{n}\left(1 + \frac{1+5{\cdot}5\rho^2}{n}\right) \quad \text{.....(ii).}$$

Soper also by assuming a Pearson curve of limited range + 1 to − 1 of type

$$y = y_0\left(1 - \frac{x}{a_1}\right)^{m_1}\left(1 + \frac{x}{a_2}\right)^{m_2}$$

deduces the modal value $\check{r}$ of r as approximately

$$\check{r} = \bar{r}\,\frac{\{1 - (\sigma_r^2 + \bar{r}^2)\}}{1 + 2\bar{r}^2 - 3(\sigma_r^2 + \bar{r}^2)} \quad \text{.....(iii),}$$

so that $\check{r}$ would be determined from a knowledge of $\bar{r}$ and $\sigma_r^2 + \bar{r}^2$.

The next step was taken by R. A. Fisher who gave in 1915† the actual frequency distribution of r, namely the curve

$$y_n = f_n(r) = \frac{(1-\rho^2)^{\frac{n-1}{2}}}{\pi(n-3)!}(1-r^2)^{\frac{n-4}{2}}\,\frac{d^{n-2}}{d(r\rho)^{n-2}}\left(\frac{\cos^{-1}(-\rho r)}{\sqrt{1-\rho^2 r^2}}\right) \quad \text{.....(iv).}$$

Except for very low values of n this expression for y_n does not provide a formula from which the ordinates of the frequency curve for r can be readily determined, and as the problem was left by Fisher there were no rapid means of numerically determining either $\bar{r}$ or $\check{r}$ or again σ_r^2.

Clearly in order to determine the approach to Soper's approximations, and ultimately to the normal curve as n increases we require expressions for the moment coefficients of (iv), and further for practical purposes we require to table the ordinates of (iv) in the region for which n is too small for Soper's formulae to provide adequate approximations. These are the aims of the present paper. It is only fair to state that the arithmetic involved has been of the most strenuous kind and has needed months of hard work on the part of the computers engaged‡. On the other hand the algebra has often been of a most interesting and suggestive character.

(2) *On Properties of the Function* $U = \cos^{-1}(-x)/\sqrt{1-x^2}$.

We have

$$\frac{dU}{dx} = \frac{1}{1-x^2} + \frac{x\cos^{-1}(-x)}{(1-x^2)^{\frac{3}{2}}},$$

or

$$(1-x^2)\frac{dU}{dx} = 1 + xU.$$

* See *loc. cit.* pp. 105 and 107. † *Biometrika*, Vol. x. p. 507 *et seq.*

‡ Besides those whose names are given under the title, we have to thank I. Horwitz for some calculating aid, Ethel M. Elderton and D. Heron for occasional assistance, especially in the experimental part of the work, and lastly but very far from least we have to acknowledge the untiring work of H. Gertrude Jones and Adelaide G. Davin in the construction of the models the beauty and accuracy of which are not more than suggested in the plates.

Apply Leibnitz's Theorem and we have

$$(1-x^2)\frac{d^nU}{dx^n} - 2x(n-1)\frac{d^{n-1}U}{dx^{n-1}} - 2\frac{(n-1)(n-2)}{1\,.\,2}\frac{d^{n-2}U}{dx^{n-2}} = x\frac{d^{n-1}U}{dx^{n-1}} + (n-1)\frac{d^{n-2}U}{dx^{n-2}},$$

or,
$$(1-x^2)\frac{d^nU}{dx^n} - x(2n-1)\frac{d^{n-1}U}{dx^{n-1}} - (n-1)^2\frac{d^{n-2}U}{dx^{n-2}} = 0 \quad \text{.....(v).}$$

Put $x = 0$ and we have

$$\left(\frac{d^nU}{dx^n}\right)_0 = (n-1)^2\left(\frac{d^{n-2}U}{dx^{n-2}}\right)_0,$$

but clearly $U_0 = \frac{1}{2}\pi$ and $(dU/dx)_0 = 1$.

Hence by Maclaurin's Theorem

$$\frac{\cos^{-1}(-x)}{\sqrt{1-x^2}} = \frac{\pi}{2}\left(1 + \frac{1^2}{2!}x^2 + \frac{3^2\,.\,1^2}{4!}x^4 + \ldots + \frac{(2s-1)^2(2s-3)^2\ldots 1^2}{(2s)!}x^{2s} + \ldots\right)$$
$$+\left(x + \frac{2^2}{3!}x^3 + \frac{4^2\,.\,2^2}{5!}x^5 + \ldots + \frac{(2s)^2(2s-2)^2\ldots 2^2}{(2s+1)!}x^{2s+1} + \ldots\right)\text{...(vi).}$$

We are now in a position to give the successive differentials of U which may be either even or odd. We have for the two cases

$$\frac{d^{2s}}{dx^{2s}}\left\{\frac{\cos^{-1}(-x)}{\sqrt{1-x^2}}\right\}$$
$$= \frac{\pi}{2}(2s-1)^2(2s-3)^2\ldots 1^2\left\{1 + \frac{(2s+1)^2}{2!}x^2 + \frac{(2s+1)^2(2s+3)^2}{4!}x^4 + \ldots\right\}$$
$$+ (2s)^2(2s-2)^2\ldots 2^2\left\{x + \frac{(2s+2)^2}{3!}x^3 + \frac{(2s+2)^2(2s+4)^2}{5!}x^5 + \ldots\right\}\text{...(vii),}$$

$$\frac{d^{2s-1}}{dx^{2s-1}}\left\{\frac{\cos^{-1}(-x)}{\sqrt{1-x^2}}\right\}$$
$$= \frac{\pi}{2}(2s-1)^2(2s-3)^2\ldots 1^2\left\{x + \frac{(2s+1)^2}{3!}x^3 + \frac{(2s+1)^2(2s+3)^2}{5!}x^5 + \ldots\right\}$$
$$+ (2s-2)^2(2s-4)^2\ldots 2^2\left\{1 + \frac{(2s)^2}{2!}x^2 + \frac{(2s)^2(2s+2)^2}{4!}x^4 + \ldots\right\}\text{...(vii)}^{\text{bis}},$$

the development of the several series being clear.

For calculation of y_{2s} or y_{2s-1} the above series are idle, just as they are when substituted in the equation for $dy_n/dr = 0$ which gives $\check{r}$. They converge far too slowly to be of use for numerical evaluations. But as we shortly shall show, they are, after certain transformations, most valuable in determining the moment coefficients.

Now
$$y_n = \frac{(1-\rho^2)^{\frac{n-1}{2}}}{\pi(n-3)!}(1-r^2)^{\frac{n-4}{2}}\frac{d^{n-2}U}{dx^{n-2}};$$

multiply (v) by
$$(1-\rho^2)^{\frac{n+1}{2}}(1-r^2)^{\frac{n-2}{2}}\Big/(\pi(n-1)!),$$

and we have

$$(1-\rho^2r^2)\,y_{n+2}-\frac{\rho r\,(2n-1)\sqrt{1-\rho^2}\sqrt{1-r^2}}{n-1}\,y_{n+1}-\frac{(1-\rho^2)(1-r^2)}{(n-1)\,(n-2)}\,(n-1)^2\,y_n=0,$$

thus

$$y_{n+2}=\frac{2n-1}{n-1}\,\kappa_1 y_{n+1}+\frac{n-1}{n-2}\,\kappa_2 y_n \quad \text{.....(viii).}$$

Here

$$\kappa_1=\frac{\rho r\sqrt{1-\rho^2}\sqrt{1-r^2}}{1-\rho^2r^2}, \qquad \kappa_2=\frac{(1-\rho^2)\,(1-r^2)}{1-\rho^2r^2}$$

are constant for ρ and r given and thus (viii) enables us to deduce y_{n+2} from y_{n+1} and y_n for a given ρ and r. But by simple differentiation

$$\left.\begin{aligned} y_3&=\frac{1-\rho^2}{\pi\sqrt{1-r^2}}\left(\frac{1}{1-\rho^2r^2}+\frac{\rho r\cos^{-1}(-\rho r)}{(1-\rho^2r^2)^{\frac{3}{2}}}\right)\\ y_4&=\frac{(1-\rho^2)^{\frac{3}{2}}}{\pi}\left(\frac{3\rho r}{(1-\rho^2r^2)^2}+\frac{(1+2\rho^2r^2)\cos^{-1}(-\rho r)}{(1-\rho^2r^2)^{\frac{5}{2}}}\right)\end{aligned}\right\} \quad \text{.....(ix).}$$

Hence if y_3 and y_4 be calculated for a series of values of r and ρ all higher values may be reached by a repeated use of (viii). The values chosen were: ρ proceeding by ·1 from 0 to 1 and r proceeding by ·05 from -1 to $+1$.

The disadvantage of this method of calculating y_n is that, except by independent computing, there is no means of checking accuracy until all the ordinates have been deduced, and any mistake in y_n for a low value of n is perpetuated throughout the series. When all the ordinates have been found, say for $n=25$, then the smoothness of these ordinates and the fact that they give the correct total area with a suitable graduation-formula will be checks on the accuracy of the whole system of ordinates. In this manner Table A, p. 379, was calculated.

Another method of approaching the value of y_n is of some advantage. We may take

$$y_n=\frac{(1-\rho^2)^{\frac{n-1}{2}}}{\pi\,(n-3)!}\,(1-r^2)^{\frac{n-4}{2}}\left(\frac{v_n}{(1-\rho^2r^2)^{n-2}}+\frac{u_n\cos^{-1}(-\rho r)}{(1-\rho^2r^2)^{\frac{2n-3}{2}}}\right) \quad \text{.....(x),}$$

where v_n and u_n are functions of ρr in integer positive powers, and if we substitute in (viii) we obtain

$$\left.\begin{aligned} v_{n+2}&=(2n-1)\,\rho r v_{n+1}+(n-1)^2\,(1-\rho^2r^2)\,v_n\\ u_{n+2}&=(2n-1)\,\rho r u_{n+1}+(n-1)^2\,(1-\rho^2r^2)\,u_n\end{aligned}\right\} \quad \text{.....(xi).}$$

We may write y_n in the form

$$y_n=\frac{n-2}{(n-2)!}\,\frac{(1-\rho^2)^{\frac{n-1}{2}}}{\pi}\,(1-r^2)^{\frac{n-4}{2}}\,\frac{d^{n-2}}{d\,(\rho r)^{n-2}}\left\{\frac{\cos^{-1}(-\rho r)}{\sqrt{1-\rho^2r^2}}\right\},$$

or

$$y_2=(n-2)_{n-2}\,\frac{\sqrt{1-\rho^2}}{\pi\,(1-r^2)}\left(\frac{0}{(1-\rho^2r^2)^0}+\frac{\cos^{-1}(-\rho r)}{(1-\rho^2r^2)^{\frac{1}{2}}}\right).$$

Hence $v_2 = 0$ and $u_2 = 1$, while y_2 will vanish for all values of r, except $r = \pm 1$ owing to the factor $(n-2)_{n=2}$. Thus (ix) gives us

$$v_3 = 1, \qquad u_3 = \rho r,$$

whence by (xi)

$$v_4 = 3\rho r, \qquad u_4 = 1 + 2\rho^2 r^2,$$

$$v_5 = 4 + 11\rho^2 r^2, \qquad u_5 = \rho r\,(9 + 6\rho^2 r^2),$$

$$v_6 = \rho r\,(55 + 50\rho^2 r^2), \qquad u_6 = 9 + 72\rho^2 r^2 + 24\rho^4 r^4,$$

and the successive values can be rapidly calculated, much faster than by actually differentiating out (iv). It is, however, shortest to insert the numerical values of ρ and r in (xi) and deduce the v_n's and u_n's numerically in succession. (Table A was, however, in the present case deduced from (viii). We did this by direct calculation of the values of

$$\left(\frac{y_n}{n-2}\right)_{n=2} = \frac{\sqrt{1-\rho^2}}{\pi\,(1-r^2)}\,\frac{\cos^{-1}(-\rho r)}{(1-\rho^2 r^2)^{\frac{1}{2}}},$$

and y_3 in equation (ix). Equation (viii) then gave us the numerical values of y_4, y_5, etc. in succession.)

We may write (x) in the form

$$y_n = \frac{(1-\rho^2)^{\frac{3}{2}}}{\pi}\,V_n\,(v_n + u_n U) \qquad \text{.....(xii),}$$

where $$V_n = \frac{\{(1-\rho^2)\,(1-r^2)\}^{\frac{n-4}{2}}}{(n-3)\,!\,(1-\rho^2 r^2)^{n-2}} \quad \text{and} \quad U = \frac{\cos^{-1}(-\rho r)}{\sqrt{1-\rho^2 r^2}}.$$

Here V_n, v_n, u_n and U are symmetrical in ρ and r and accordingly ρ and r can be interchanged. The problem approached this way involves:

(*a*) calculating $(1-\rho^2)^{\frac{3}{2}}/\pi$ for various values of ρ;

(*b*) U for various values of ρr;

(*c*) V_n for various values of ρ, r and n;

(*d*) determining u_n and v_n in succession from (xi) for various values of ρr and n.

Lastly we may use the series for y_n to be given later (see Eqn. (xliii)) which develops y_n in inverse powers of $(n-1)$. Actually we have adopted (viii) for tabling the ordinates of the first 25 curve-series, and the last expansion for verification and higher cases.

(3) *On the Determination of the Moment Coefficients.* We shall next determine the value of the moment coefficients about $r = 0$, as origin, and shall deal with the even and odd coefficients independently. Let them be μ'_{2p} and μ'_{2p+1}. Clearly, the total area having been taken as unity:

$$\mu'_{2p} = \int_{-1}^{+1} y_n r^{2p} dr$$

$$= \frac{(1-\rho^2)^{\frac{n-1}{2}}}{\pi\,(n-3)!} \int_{-1}^{+1} (1-r^2)^{\frac{n-4}{2}} r^{2p} \frac{d^{n-2}U}{d\,(\rho r)^{n-2}}\, dr.$$

Now

$$r^{2p} = r^{2p} - (r^2-1)^p + (-1)^p (1-r^2)^p$$

$$= p r^{2p-2} - \frac{p\,(p-1)}{2!} r^{2p-4} + \frac{p\,(p-1)\,(p-2)}{3!} r^{2p-6} - \ldots + (-1)^p (1-r^2)^p.$$

Hence

$$\mu'_{2p} = p\mu'_{2p-2} - \frac{p(p-1)}{2!}\mu'_{2p-4} + \frac{p\,(p-1)\,(p-2)}{3!}\mu'_{2p-6} - \ldots + (-1)^p \chi_{2p} \quad \text{(xiii)},$$

where $$\chi_{2p} = \frac{(1-\rho^2)^{\frac{n-1}{2}}}{\pi\,(n-3)!} \int_{-1}^{+1} (1-r^2)^{\frac{n-4+2p}{2}} \frac{d^{n-2}U}{d\,(\rho r)^{n-2}}\, dr.$$

Thus using (vii)^{bis} on the assumption that n is odd and remembering that odd powers of r will now disappear we reach:

$$\chi_{2p} = \frac{(1-\rho^2)^{\frac{n-1}{2}}}{\pi\,(n-3)!} (n-3)^2 (n-5)^2 \ldots 2^2 \left(i_0 + \frac{(n-1)^2}{2!}\rho^2 i_2 + \frac{(n+1)^2 (n-1)^2}{4!}\rho^4 i_4 + \ldots \right),$$

where $$i_{2m} = \int_{-1}^{+1} (1-r^2)^{\frac{n-4+2p}{2}} r^{2m} dr.$$

Now we may write $r = \cos\phi$, so that

$$i_{2m} = 2\int_0^{\frac{\pi}{2}} \sin^{n+2p-3}\phi \cos^{2m}\phi\, d\phi,$$

and we have $$i_{2m} = \frac{2m-1}{n+2p-3+2m}\, i_{2m-2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\text{(xiv)}.$$

Thus

$$\chi_{2p} = \frac{(1-\rho^2)^{\frac{n-1}{2}}}{\pi\,(n-3)!} (n-3)^2 (n-5)^2 \ldots 2^2 i_0 \left(1 + \frac{(n-1)^2}{2!}\rho^2 \frac{1}{n-1+2p} + \frac{(n+1)^2 (n-1)^2}{4!}\rho^4 \frac{1}{n-1+2p}\, \frac{3}{n+1+2p} + \ldots \right)$$

$$= \frac{(1-\rho^2)^{\frac{n-1}{2}}}{\pi\,(n-3)!} (n-3)^2 (n-5)^2 \ldots 2^2 i_0 F\left(\frac{n-1}{2},\ \frac{n-1}{2},\ \frac{n-1}{2}+p,\ \rho^2 \right),$$

where F as usual denotes the hypergeometrical series. But by a well-known transformation due to Euler

$$F(\alpha,\ \beta,\ \gamma,\ x) = (1-x)^{\gamma-\alpha-\beta} F(\gamma-\alpha,\ \gamma-\beta,\ \gamma,\ x) \quad \ldots\ldots\text{(xv)},$$

and accordingly

$$F\left(\frac{n-1}{2},\ \frac{n-1}{2},\ \frac{n-1}{2}+p,\ \rho^2\right)=(1-\rho^2)^{p-\frac{n-1}{2}}F\left(p,\ p,\ \frac{n-1}{2}+p,\ \rho^2\right)$$

or $$\chi_{2p}=\frac{(1-\rho^2)^p}{\pi\,(n-3)!}(n-3)^2(n-5)^2\ldots 2^2 i_0\,.\,F\left(p,\ p,\ \frac{n-1}{2}+p,\ \rho^2\right).$$

Now $$i_0=2\int_0^{\frac{\pi}{2}}\sin^{n+2p-3}\phi\,d\phi=2q_{n+2p-2},\ \text{say},$$

and $$2q_n=2\int_0^{\frac{\pi}{2}}\sin^{n-1}\phi\,d\phi$$

is known to be $$=\frac{(n-2)(n-4)\ldots 1}{(n-1)(n-3)\ldots 2}\pi \quad\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{(xvi)},$$

if n be odd as supposed above. Thus finally we have

$$\chi_{2p}=(1-\rho^2)^p\frac{q_{n+2p-2}}{q_{n-2}}F\left(p,\ p,\ \frac{n-1}{2}+p,\ \rho^2\right)\quad\ldots\ldots\ldots\text{(xvii)}.$$

A Table of $q_n=\int_0^{\frac{\pi}{2}}\sin^{n-1}\phi\,d\phi$ from $n=1$ to $n=105$ is given on p. 377 below.

Now (xvii) has only been proved for n odd. If n be even we must take the first series of (vii) and this gives

$$\chi_{2p}=\frac{(1-\rho^2)^{\frac{n-1}{2}}}{\pi\,(n-3)!}\frac{\pi}{2}(n-3)^2(n-5)^2\ldots\ldots 1^2 i_0'\left(1+\frac{(n-1)^2}{2!}\rho^2\frac{1}{n+2p-1}\right.$$
$$\left.+\frac{(n+1)^2(n-1)^2}{4!}\rho^4\frac{1}{n+2p-1}\cdot\frac{3}{n+2p+1}+\ldots\right),$$

where $$i_0'=2\int_0^{\frac{\pi}{2}}\sin^{n+2p-3}\phi\,d\phi=2q_{n+2p-2}$$

and $$2q_n=\frac{(n-2)(n-4)\ldots 2}{(n-1)(n-3)\ldots 3}\,.\,2\quad\ldots\ldots\ldots\ldots\ldots\ldots\text{(xviii)},$$

since n is even. Thus

$$\chi_{2p}=(1-\rho^2)^{\frac{n-1}{2}}\frac{q_{n+2p-2}}{q_{n-2}}F\left(\frac{n-1}{2},\ \frac{n-1}{2},\ \frac{n-1}{2}+p,\ \rho^2\right)$$
$$=(1-\rho^2)^p\frac{q_{n+2p-2}}{q_{n-2}}F\left(p,\ p,\ \frac{n-1}{2}+p,\ \rho^2\right)\quad\ldots\ldots\ldots\ldots\ldots\text{(xix)},$$

or (xvii) holds whether n be even or odd.

As particular cases we have for $p=1$

$$\mu_2'=\bar{r}^2+\sigma_r^2=1-\chi_2$$
$$=1-\frac{q_n}{q_{n-2}}(1-\rho^2)\left(1+\frac{2^2}{n+1}\frac{\rho^2}{2}+\frac{2^2\,.\,4^2}{1\,.\,2\,(n+1)\,(n+3)}\frac{\rho^4}{4}\right.$$
$$\left.+\frac{2^2\,.\,4^2\,.\,6^2}{1\,.\,2\,.\,3\,.\,(n+1)\,(n+3)\,(n+5)}\frac{\rho^6}{8}+\ldots\right)$$
$$\ldots\ldots\ldots\ldots\ldots\text{(xx)},$$

or $$\sigma_r^2 = 1 - \bar{r}^2 - \frac{n-2}{n-1}(1-\rho^2)\left(1 + \frac{2^2}{n+1}\frac{\rho^2}{2} + \frac{2^2 \cdot 4^2}{1 \cdot 2 \cdot (n+1)(n+3)}\frac{\rho^4}{4} + \frac{2^2 \cdot 4^2 \cdot 6^2}{1 \cdot 2 \cdot 3 \cdot (n+1)(n+3)(n+5)}\frac{\rho^6}{8} + \ldots\right)$$

.....(xx)^{bis},

and again for $p = 2$

$$\mu_4' = \mu_4 + 4\mu_3'\mu_1' - 6\mu_2'\mu_1'^2 + 3\mu_1'^4$$

$$= 2\mu_2' - 1 + \frac{n(n-2)}{(n+1)(n-1)}(1-\rho^2)^2\left\{1 + \frac{4^2}{n+3}\frac{\rho^2}{2} + \frac{4^2 \cdot 6^2}{1 \cdot 2 \cdot (n+3)(n+5)}\frac{\rho^4}{4} + \frac{4^2 \cdot 6^2 \cdot 8^2}{1 \cdot 2 \cdot 3 \cdot (n+3)(n+5)(n+7)}\frac{\rho^6}{8} + \ldots\right\}$$ .....(xxi).

The series in (xx) and (xxi) for $n = 25$ and upwards converge with sufficient rapidity to determine μ_2' and μ_4' rapidly and therefore with accurate values for μ_1' and μ_3' will give μ_2 or σ_r^2 and μ_4, and thus provide the determination of β_2.

We will now determine μ'_{2p+1} in like manner. We have

$$\mu'_{2p+1} = \frac{(1-\rho^2)^{\frac{n-1}{2}}}{\pi(n-3)!}\int_{-1}^{+1}(1-r^2)^{\frac{n-4}{2}} r^{2p+1}\frac{d^{n-2}U}{d(\rho r)^{n-2}}\,dr,$$

but

$$r^{2p+1} = r\{r^{2p} - (r^2-1)^p + (-1)^p(1-r^2)^p\}$$

$$= r\left\{pr^{2p-2} - \frac{p(p-1)}{2!}r^{2p-4} + \frac{p(p-1)(p-2)}{3!}r^{2p-6} - \ldots + (-1)^p(1-r^2)^p\right\}.$$

Hence $$\mu'_{2p+1} = p\mu'_{2p-1} - \frac{p(p-1)}{2!}\mu'_{2p-3} + \frac{p(p-1)(p-2)}{3!}\mu'_{2p-5} - \ldots\ldots + (-1)^p\chi_{2p+1}$$ .....(xxii),

where

$$\chi_{2p+1} = \frac{(1-\rho^2)^{\frac{n-1}{2}}}{\pi(n-3)!}\int_{-1}^{+1}(1-r^2)^{\frac{n-4+2p}{2}} r\frac{d^{n-2}U}{d(r\rho)^{n-2}}\,dr$$

$$= \frac{(1-\rho^2)^{\frac{n-1}{2}}}{\pi(n-3)!}\frac{1}{n-2+2p}\int_{-1}^{+1}\frac{d^{n-2}U}{d(r\rho)^{n-2}}\,d\left(-(1-r^2)^{\frac{n-2+2p}{2}}\right),$$

or integrating by parts

$$= \frac{\rho(1-\rho^2)^{\frac{n-1}{2}}}{\pi(n-3)!\,(n-2+2p)}\int_{-1}^{+1}(1-r^2)^{\frac{n-2+2p}{2}}\frac{d^{n-1}U}{d(r\rho)^{n-1}}\,dr.$$

Assuming n odd we must keep the first series in the value of $\dfrac{d^{n-1}U}{d(r\rho)^{n-1}}$, and we reach

$$\chi_{2p+1} = \frac{\rho(1-\rho^2)^{\frac{n-1}{2}}}{\pi(n-3)!\,(n-2+2p)}\frac{\pi}{2}(n-2)^2(n-4)^2\ldots 1^2\,.\,2q_{n+2p}$$
$$\times\left(1+\frac{n^2}{2!}\rho^2\frac{1}{n+1+2p}+\frac{n^2(n+2)^2}{4!}\frac{1}{n+1+2p}\frac{3}{n+3+2p}\rho^4+\text{etc.}\ldots\right)$$
$$=\frac{\rho(1-\rho^2)^{\frac{n-1}{2}}}{2\,(n-3)!\,(n-2+2p)}2q_{n+2p}(n-2)^2(n-4)^2\ldots 1^2$$
$$\times F\left(\frac{n}{2},\frac{n}{2},\frac{n+1}{2}+p,\rho^2\right)$$
$$=\frac{\rho(1-\rho^2)^p(n-2)}{n-2+2p}\frac{q_{n+2p}}{q_{n-1}}F\left(p+\frac{1}{2},p+\frac{1}{2},\frac{n+1}{2}+p,\rho^2\right)\quad\ldots\ldots\text{(xxiii)},$$

if we use Euler's reduction formula, and note that for n odd, or $n-1$ even ·

$$2q_{n-1}=\frac{(n-3)(n-5)\ldots 2}{(n-2)(n-4)\ldots 1}\,.\,2.$$

If we start with n even we reach an absolutely identical formula by a different route. Thus we have

$$\mu'_{2p+1}=p\mu'_{2p-1}-\frac{p(p-1)}{2!}\mu'_{2p-3}+\frac{p(p-1)(p-2)}{3!}\mu'_{2p-5}-\ldots$$
$$+(-1)^p\frac{\rho(1-\rho^2)^p(n-2)}{n-2+2p}\frac{q_{n+2p}}{q_{n-1}}F\left(p+\frac{1}{2},p+\frac{1}{2},\frac{n+1}{2}+p,\rho^2\right)$$
$$\ldots\ldots\ldots\ldots\text{(xxiv)}.$$

Taking p in succession equal to zero and to unity we find

$$\mu_1'=\bar{r}=\rho\frac{q_n}{q_{n-1}}\left(1+\frac{1^2}{n+1}\frac{\rho^2}{2}+\frac{1^2\,.\,3^2}{1\,.\,2\,.\,(n+1)(n+3)}\frac{\rho^4}{4}\right.$$
$$\left.+\frac{1^2\,.\,3^2\,.\,5^2}{3!\,(n+1)(n+3)(n+5)}\frac{\rho^6}{8}+\ldots\right)\ldots\ldots\text{(xxv)},$$

$$\mu_3'=\mu_3+3\mu_2'\bar{r}-2\bar{r}^3=\bar{r}-\rho(1-\rho^2)\frac{q_{n+2}}{q_{n-1}}\frac{n-2}{n}$$
$$\times\left(1+\frac{3^2}{n+3}\frac{\rho^2}{2}+\frac{3^2\,.\,5^2}{1\,.\,2\,(n+3)(n+5)}\frac{\rho^4}{4}+\frac{3^2\,.\,5^2\,.\,7^2}{3!\,(n+3)(n+5)(n+7)}\frac{\rho^6}{8}+\ldots\right)$$
$$\ldots\ldots\ldots\ldots\text{(xxvi)}.$$

Equations (xxv) and (xxvi) provide the values of the odd moment coefficients about zero and this in fairly rapidly converging series. From them we can deduce the value about the mean μ_3 and thus find the fundamental β_1. Table X, p. 377, again gives the requisite values of q_n for the range $n=1$ to 105.

Illustration. Samples of 25 are taken out of a population in which two variates have the correlation $\rho = \cdot 6$. Determination of the nature of the distribution of r in these samples.

Here $n = 25$, and with $\rho = \cdot 6$ we find from (xx), (xxi), (xxv) and (xxvi) the values*

$$\mu_1' = \bar{r} = \cdot 591{,}825, \qquad \mu_2' = \cdot 368{,}739,$$
$$\mu_3' = \cdot 238{,}293, \qquad \mu_4' = \cdot 158{,}510.$$

Further
$$\mu_2 = \cdot 018{,}482, \qquad \sigma_r = \cdot 135{,}950,$$
$$\mu_3 = -\cdot 001{,}812{,}380, \qquad \mu_4 = \cdot 001{,}279{,}141,$$

giving
$$\beta_1 = \cdot 520{,}265, \qquad \beta_2 = 3 \cdot 744{,}573.$$

The distribution is thus very far from normal.

Hence by the formula†:

$$\text{Distance from mean to mode} = \frac{\sigma_r \sqrt{\beta_1}\,(\beta_2 + 3)}{2\,(5\beta_2 - 6\beta_1 - 9)} \qquad \text{.....(xxvii)}$$

we find
$$\check{r} - \bar{r} = \cdot 050{,}094,$$
$$\check{r} = \cdot 64192.$$

We shall see later that the actual value is
$$\check{r} = \cdot 64194,$$
or the approximation is very close.

The skewness is given by
$$Sk. = (\check{r} - \bar{r})/\sigma_r = \cdot 36847,$$
thus indicating that there is but little approach to normality.

Fig. 1, p. 338, shows the excellent fit of a Pearson curve of Type II to the distribution. The equation is

$$y = \cdot 31004 \left(1 - \frac{x}{\cdot 31075}\right)^{5 \cdot 7536} \left(1 + \frac{x}{9 \cdot 64157}\right)^{178 \cdot 5135}$$

We see that when $n = 25$, Pearson's curves—fitted by moments not by range—adequately describe the frequencies, but there is still no real approach to a Gaussian distribution.

The series-expansions which have been given for the determination of the moments are of very little service when n is less than 25. We have therefore to consider formulae for deducing in succession the moments about $r = 0$ for $n = 5$ to $n = 25$.

* The values were in every case worked out to nine places of decimals.

† Pearson: Mathematical Contributions to the Theory of Evolution, XII, p. 7. *Drapers' Company Research Memoirs, Biometric Series,* Cambridge University Press.

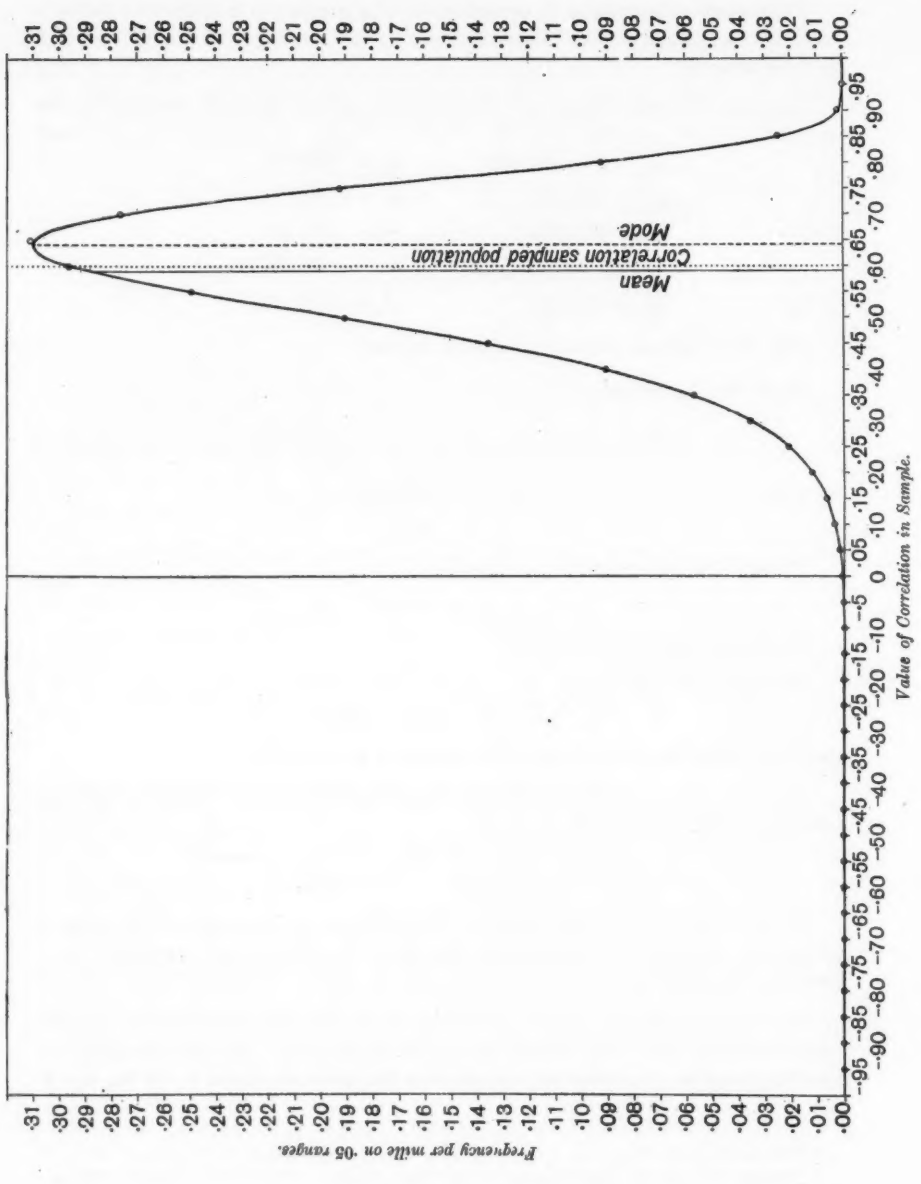


FIG. 1. Comparison of Values of Frequency Ordinates for $n=25$, $\rho=0{\cdot}6$ as given by complete theory and by a Pearson Skew Curve of Frequency. The dots mark true ordinates.

By (xxv)

$$\bar{r}_{n+2} = \rho \frac{q_{n+2}}{q_{n+1}} \left(1 + \frac{1^2}{n+3}\frac{\rho^2}{2} + \ldots + \frac{1 \,.\, 3^2 \ldots (2s-1)^2}{s!\,(n+3)\,(n+5) \ldots (n+2s+1)} \frac{\rho^{2s}}{2^s} + \ldots\right),$$

$$\bar{r}_n = \rho \frac{q_n}{q_{n-1}} \left(1 + \frac{1^2}{n+1}\frac{\rho^2}{2} + \ldots + \frac{1^2 \,.\, 3^2 \ldots (2s-1)^2}{s!\,(n+1)\,(n+3) \ldots (n+2s-1)} \frac{\rho^{2s}}{2^s} + \ldots\right),$$

$$\bar{r}_{n+2} - \bar{r}_n = \rho \frac{q_{n+2}}{q_{n-1}} \left\{\frac{n}{n-1}\left(1 + \frac{1^2}{n+3}\frac{\rho^2}{2} + \ldots + \frac{1^2 \,.\, 3^2 \ldots (2s-1)^2}{s!\,(n+3)\,(n+5) \ldots (n+2s+1)} \frac{\rho^{2s}}{2^s} + \ldots\right)\right.$$

$$\left. - \frac{n+1}{n}\left(1 + \frac{1^2}{n+1}\frac{\rho^2}{2} + \ldots + \frac{1^2 \,.\, 3^2 \ldots (2s-1)^2}{s!\,(n+1)\,(n+3) \ldots (n+2s-1)} \frac{\rho^{2s}}{2^s} + \ldots\right)\right\},$$

since

$$\frac{q_{n-1}}{q_{n+1}} = \frac{n}{n-1}$$

The general term is therefore

$$\frac{1}{(n-1)\,(n-2)}\,\rho\,\frac{q_{n+2}}{q_{n-1}}\,\frac{n-2}{n}\left(\frac{n^2\,(n+1)}{n+2s+1} - (n^2-1)\right) \times \frac{1^2 \,.\, 3^2 \ldots (2s-1)^2}{s!\,(n+1)\,(n+3) \ldots (n+2s-1)} \frac{\rho^{2s}}{2^s}$$

Now in (xxvi) we have seen that

$$\bar{r}_n - \mu'_{3,n} = \rho\,(1-\rho^2)\,\frac{q_{n+2}}{q_{n-1}}\,\frac{n-2}{n}\left\{1 + \frac{3^2}{n+3}\frac{\rho^2}{2} + \ldots + \frac{3^2 \,.\, 5^2 \ldots (2s+1)^2}{s!\,(n+3)\,(n+5) \ldots (n+2s+1)} \frac{\rho^{2s}}{2^s} + \ldots\right\},$$

and the general term is

$$\rho \frac{q_{n+2}}{q_{n-1}} \frac{n-2}{n} \left(\frac{3^2 \,.\, 5^2 \ldots (2s+1)^2}{s!\,(n+3)\,(n+5) \ldots (n+2s+1)} - \frac{2 \,.\, 3^2 \,.\, 5^2 \ldots (2s-1)^2}{(s-1)!\,(n+3)\,(n+5) \ldots (n+2s-1)} \frac{\rho^{2s}}{2^s}\right.$$

$$= \rho \frac{q_{n+2}}{q_{n-1}} \frac{n-2}{n} \left(\frac{(2s+1)^2}{n+2s+1} - 2s\right) \frac{1^2 \,.\, 3^2 \,.\, 5^2 \ldots (2s-1)^2}{s!\,(n+3)(n+5) \ldots (n+2s-1)} \frac{\rho^{2s}}{2^s}$$

$$= \rho \frac{q_{n+2}}{q_{n-1}} \frac{n-2}{n} \frac{(n+1)\,(1-2s\,(n-1))}{n+2s+1} \frac{1^2 \,.\, 3^2 \,.\, 5^2 \ldots (2s-1)^2}{s!\,(n+1)\,(n+3) \ldots (n+2s-1)} \frac{\rho^{2s}}{2^s}$$

$$= \rho \frac{q_{n+2}}{q_{n-1}} \frac{n-2}{n} \left(\frac{n^2\,(n+1)}{n+2s+1} - (n^2-1)\right) \times \frac{1^2 \,.\, 3^2 \,.\, 5^2 \ldots (2s-1)^2}{s!\,(n+1)\,(n+3)\,(n+5) \ldots (n+2s+1)} \frac{\rho^{2s}}{2^s}$$

$$= (n-1)\,(n-2)\,(\bar{r}_{n+2} - \bar{r}_n).$$

Hence

$$\bar{r}_{n+2} - \bar{r}_n = \frac{\bar{r}_n - \mu'_{3,n}}{(n-1)\,(n-2)} \qquad \text{(xxviii)}.$$

Value of Correlation in Sample.

This result expresses the mean for samples of $n+2$ in terms of the mean for samples of n and the third moment of samples of n.

Next let

$$\chi_{2p,n} = \frac{(1-\rho^2)^{\frac{n-1}{2}}}{\pi\,(n-3)!}\int_{-1}^{+1}(1-r^2)^{\frac{n-4+2p}{2}}\frac{d^{n-2}U}{d\,(\rho r)^{n-2}}\,dr$$

$$= \frac{(1-\rho^2)^{\frac{n-1}{2}}}{\pi\,(n-3)!}f_{p,n}.$$

Now integrate $f_{p,n}$ by parts *twice*:

$$f_{p,n} = \frac{n-4+2p}{\rho}\int_{-1}^{+1} r\,(1-r^2)^{\frac{n-6+2p}{2}}\frac{d^{n-3}U}{d\,(\rho r)^{n-3}}\,dr$$

$$= \frac{n-4+2p}{\rho}\int_{-1}^{+1}\{(n-6+2p)\,(1-r^2)^{\frac{n-8+2p}{2}} - (n-6+2p+1)\,(1-r^2)^{\frac{n-6+2p}{2}}\}\times\frac{d^{n-4}U}{d\,(\rho r)^{n-4}}\,dr$$

$$= \frac{n-4+2p}{\rho^2}\{(n-6+2p)f_{p-1,n-2} - (n-6+2p+1)f_{p,n-2}\}.$$

Or returning to the $\chi_{2p,n}$ notation

$$\chi_{2p,n} = \frac{1-\rho^2}{\rho^2}\frac{n-4+2p}{(n-3)\,(n-4)}\{(n-6+2p)\chi_{2p-2,n-2} - (n-6+2p+1)\chi_{2p,n-2}\}.$$

As special cases put $p=1$ and 2, and change n to $n+2$. We have*

$$\chi_{2,n+2} = \frac{1-\rho^2}{\rho^2}\cdot\frac{n}{n-1}\cdot\left\{\chi_{0,n} - \frac{n-1}{n-2}\chi_{2,n}\right\} \quad \text{.....(xxix),}$$

$$\chi_{4,n+2} = \frac{1-\rho^2}{\rho^2}\cdot\frac{n+2}{n-1}\cdot\left\{\frac{n}{n-2}\chi_{2,n} - \frac{n+1}{n-2}\chi_{4,n}\right\}. \quad \text{.....(xxx).}$$

But $\chi_{0,n} = 1$ and $\chi_{2,n} = 1 - \mu'_{2,n}$,

$$\chi_{4,n} = 1 - 2\mu'_{2,n} + \mu'_{4,n}.$$

Accordingly

$$\mu'_{2,n+2} = 1 - \frac{1-\rho^2}{\rho^2}\frac{n}{n-2}\left(\mu'_{2,n} - \frac{1}{n-1}\right) \quad \text{.....(xxxi),}$$

which can be verified directly from (xx) or (xx)$^{\text{bis}}$. Again instead of working with the series for $\chi_{4,n+2}$ above (xxx), we can replace it by one involving the moments about $r=0$, directly:

$$\mu'_{4,n+2} = 1 - \frac{1-\rho^2}{\rho^2}\left\{\frac{(n+1)\,(n+2)}{(n-1)\,(n-2)}\mu'_{4,n} + \frac{n^2-6n-4}{(n-1)\,(n-2)}\mu'_{2,n} - \frac{1}{n-1}\right\}$$

.....(xxxii).

* The process of integrating by parts shows that we must have $n > 2$.

It remains to determine the formula for $\mu'_{3,n+2}$. We have

$$\chi_{2p+1,n} = \frac{(1-\rho^2)^{\frac{n-1}{2}}}{\pi\,(n-3)!}\int_{-1}^{+1}(1-r^2)^{\frac{n-4+2p}{2}}\,r\,\frac{d^{n-2}U}{d\,(r\rho)^{n-2}}\,dr,$$

whence by double integration by parts to reduce the U differential coefficient we obtain

$$\chi_{2p+1,n} = \frac{1-\rho^2}{\rho^2}\,\frac{n-4+2p}{(n-3)\,(n-4)}\left\{(n-6+2p)\,\chi_{2p-1,n-2} - \frac{n-4+2p+1}{n-4}\,\chi_{2p+1,n-2}\right\}.$$

Putting $p=1$ and changing n to $n+2$ we have

$$\chi_{3,n+2} = \frac{1-\rho^2}{\rho^2}\,\frac{n}{n-1}\left\{\chi_{1,n} - \frac{n+1}{n-2}\,\chi_{3,n}\right\} \quad \text{.....(xxxiii).}$$

This may again be read as a formula for $\mu'_{3,n+2}$:

$$\mu'_{3,n+2} = \bar{r}_n\left(1 - \frac{n}{n-1}\,\frac{1-\rho^2}{\rho^2}\right) + \frac{\bar{r}_n - \mu'_{3,n}}{(n-1)\,(n-2)}\left(1 + n\,(n+1)\,\frac{1-\rho^2}{\rho^2}\right) \quad \text{(xxxiv).}$$

Starting with the values of the μ's for $n=3$, 4, 25 and 26, the moment coefficients about $r=0$ have been determined for $n=5$ to 25 in succession. As controls the values for $n=20$ had already been determined and those for $n=10$ were also obtained at a very considerable expenditure of labour from the very slowly converging series of Formulae (xx), (xxi), (xxv) and (xxvi). The initial values of the moment coefficients (i.e. those for $n=3$, 4, 25 and 26) had to be calculated generally to 15 and sometimes to 20 significant figures, owing to the numerical factors in (xxviii), (xxxi), (xxxii) and (xxxiv) being frequently greater than unity, and thus errors in the last figure being repeatedly multiplied. According to the special value of ρ, it was found best sometimes to deduce moment coefficients of $n+2$ from those for n, and sometimes those of n from those for $n+2$, i.e. to work up from 3 and 4, or down from 25 and 26. It seems unnecessary to enter at length here into the many difficulties that arose in the course of these calculations. We think they have all been successfully surmounted and that our final values may be trusted to the figures actually recorded in the tables. We thus found the moment coefficients and from them the values of β_1 and β_2 for the ten values of ρ from 0 to ·9, and for the values of n, 2 to 25, 50, 100 and 400. Diagram I shows that our 270 frequency curves are fairly well distributed over the most frequently occurring portion of the β_1, β_2 plane. Now our view is that the constants β_1, β_2 describe adequately for statistical purposes the bulk of the usual frequencies distributions. But we have provided tables of the values of the ordinates for the above 270 curves. Hence *by interpolation* it will now be possible to determine rapidly ordinates which will graduate with reasonable accuracy any frequency distribution whatever quite apart from the idea of sampling normally correlated variates*.

* Francis Galton frequently insisted on the importance of forming Tables of frequency ordinates, which would graduate any frequency distribution in the β_1, β_2 plane. A scheme for covering this plane

The diagram referred to on p. 341 will appear with Part II of the paper.

In order to make use of our ordinates for graduating frequency curves we must express the distance from our origin to our mean (i.e. from $r = 0$ to $r = \bar{r}_n$) in terms of the standard deviation, and further the unit of argument of the abscissae, i.e. ·05 in r, also in terms of the standard deviation. Our interpolated frequency ordinates (reduced of course, to the size of the actual population) will then have to be plotted to intervals of $\cdot 05\sigma_g/\sigma_r$, the origin being $\bar{r}_n\sigma_g/\sigma_r$ from the mean of the graduated data, where σ_g is the standard deviation of the graduated data. Care must be taken to so choose the axis of abscissae of the graduated data that the sign of μ_3 is the same in the graduated material and the graduating frequencies. Table C gives the distance from the mean to the origin of coordinates in each case and also the abscissal unit for plotting both in terms of the standard deviation.

(4) *On the Determination of the Mode.* Differentiating (iv) we have

$$\frac{dy_n}{dr} = \frac{(1-\rho^2)^{\frac{n-1}{2}}}{\pi\,(n-3)!}\left\{(1-r^2)^{\frac{n-4}{2}}\,\rho\,\frac{d^{n-1}U}{d\,(r\rho)^{n-1}} - r\,(n-4)\,(1-r^2)^{\frac{n-6}{2}}\,\frac{d^{n-2}U}{d\,(r\rho)^{n-2}}\right\}$$

Hence the mode $\check{r}$ is given by

$$0 = (1-\check{r}^2)\,\rho^2\left(\frac{d^{n-1}U}{d\,(r\rho)^{n-1}}\right) - \check{r}\rho\,\frac{d^{n-2}U}{d\,(r\rho)^{n-2}}\,(n-4),$$

or writing $\check{\rho}^2 = \check{r}\rho$, we have

$$(\rho^2 - \check{\rho}^4)\,\frac{d^{n-1}\check{U}}{d\,(\check{\rho}^2)^{n-2}} = (n-4)\,\check{\rho}^2\,\frac{d^{n-2}\check{U}}{d\,(\check{\rho}^2)^{n-2}} \quad \text{.....(xxxv),}$$

where $\check{U}$ is U with $\check{\rho}$ put for $r\rho$.

Now (xxxv) is by no means easy to solve adequately, for if we solve it by approximation, $r = \rho$ and $\check{\rho} = \rho^2$ is not sufficiently close for an effective first approximation, especially when ρ differs considerably from zero. We have indeed from (v) the relation

$$(1-\check{\rho}^4)\,\frac{d^{n-1}\check{U}}{d\,(\check{\rho}^2)^{n-1}} - \check{\rho}^2\,(2n-3)\,\frac{d^{n-2}\check{U}}{d\,(\check{\rho}^2)^{n-2}} - (n-2)^2\,\frac{d^{n-3}\check{U}}{d\,(\check{\rho}^2)^{n-3}} = 0 \quad \text{(xxxvi),}$$

and this might be combined with (xxxv) to deduce in succession relations between lower pairs of differential coefficients, till we ultimately reach a relation between $d\check{U}/d\check{\rho}^2$ and $\check{U}$, but the process is too laborious except for very low values of n.

Fisher has outlined another method of approaching the mode*. It is easy to see that

$$\begin{aligned}\frac{\cos^{-1}(-x)}{\sqrt{1-x^2}} &= \frac{2}{\sqrt{1-x^2}}\left(\tan^{-1}\frac{1-x}{\sqrt{1-x^2}} - \tan^{-1}\frac{-x}{\sqrt{1-x^2}}\right)\\ &= \frac{2}{\sqrt{1-x^2}}\left[\tan^{-1}\left(\frac{\xi-x}{\sqrt{1-x^2}}\right)\right]_0^1\\ &= 2\int_0^1 \frac{d\xi}{(\xi-x)^2+1-x^2} = 2\int_0^1 \frac{d\xi}{\xi^2-2x\xi+1},\end{aligned}$$

with a series of Pearson-curves has been long under consideration, but the immense labour of calculating the ordinates of 400 to 500 curves has so far prevented the actualisation of this idea. The present ordinate-tables go some way to supply the need Galton pointed out.

* *Biometrika*, Vol. x. p. 520.

or, if $\xi = e^{-z}$, $$= \int_0^\infty \frac{dz}{\cosh z - x} = \int_0^\infty \frac{dz}{\cosh z - \rho r}, \text{ if } x = \rho r.$$

But $$y_n = \frac{(1-\rho^2)^{\frac{n-1}{2}}}{\pi\,(n-3)!}(1-r^2)^{\frac{n-4}{2}}\frac{d^{n-2}}{d\,(\rho r)^{n-2}}\left(\frac{\cos^{-1}(-\rho r)}{\sqrt{1-\rho^2 r^2}}\right)$$

$$= \frac{(1-\rho^2)^{\frac{n-1}{2}}}{\pi\,(n-3)!}(1-r^2)^{\frac{n-4}{2}}\frac{d^{n-2}}{d\,(\rho r)^{n-2}}\int_0 \frac{dz}{\cosh z - \rho r}$$

$$= (n-2)\frac{(1-\rho^2)^{\frac{n-1}{2}}}{\pi}(1-r^2)^{\frac{n-4}{2}}\int_0^\infty \frac{dz}{(\cosh z - \rho r)^{n-1}} \quad \text{...(xxxvii)},$$

$$= \frac{(n-2)\,(1-\rho^2)^{\frac{n-1}{2}}}{\pi}(1-r^2)^{\frac{n-4}{2}}\,I_{n-1}, \text{ say.....(xxxvii)}^{\text{bis}}.$$

Substituting in Eqn. (viii) we find

$$n\,(1-\rho^2 r^2)\,I_{n+1} = (2n-1)\,\rho r\,I_n + (n-1)\,I_{n-1} \quad \text{.....(xxxviii)},$$

as the reduction formula for the I_n's.

Similarly, if $$I'_{n-1} = \int_0^\infty \frac{dz}{(\cosh z - \rho_0^2)^{n-1}},$$

then $$n\,(1-\rho_0^4)\,I'_{n+1} = (2n-1)\,\rho_0^2 I'_n + (n-1)\,I'_{n-1} \quad \text{...(xxxviii)}^{\text{bis}}.$$

Now using value (xxxvii)$^{\text{bis}}$ for y_n, the equation for the mode is

$$(n-4)\,\check{r}\check{I}_{n-1} = \rho\,(1-\check{r}^2)\,(n-1)\,\check{I}_n,$$

or, if as before, $\check{\rho}^2 = \rho\check{r}$, we have:

$$(n-4)\,\check{\rho}^2\check{I}_{n-1} = (\rho^2 - \check{\rho}^4)\,(n-1)\,\check{I}_n \text{.....(xxxix)}.$$

This combined with

$$n\,(1-\check{\rho}^4)\,\check{I}_{n+1} = (2n-1)\,\check{\rho}^2\check{I}_n + (n-1)\,\check{I}_{n-1} \text{ .....(xl)},$$

should determine the mode.

Now assume $\check{\rho}^2 = \rho_0^2 + \epsilon$, where ρ_0^2 is some first approximation to $\check{\rho}^2$, then we find

$$\epsilon = -\frac{(n-4)\,\rho_0^2 I'_{n-1} - (n-1)\,(\rho^2-\rho_0^4)\,I_n'}{(n-4)\,I'_{n-1} + (n-1)\,(n-2)\,\rho_0^2 I_n' - (n-1)\,(\rho^2-\rho_0^4)\,I'_{n+1}}$$

.....(xli).

If we had obtained an approximation ρ_0^2 to $\check{\rho}^2$, we could start with

$$I_1' = \frac{\cos^{-1}(-\rho_0^2)}{\sqrt{1-\rho_0^4}} \quad \text{and} \quad I_2' = \frac{1}{1-\rho_0^4} + \frac{\rho_0^2\cos^{-1}(-\rho_0^2)}{(1-\rho_0^4)^{\frac{3}{2}}} \quad \text{.....(xlii)},$$

and by aid of (xxxviii)$^{\text{bis}}$ determine the I''s in succession. If $E_n = I_n/I_{n-1}$ we can put our results in the forms (xliii) and (xliv) below, and calculate successive E's:

$$\epsilon = -\frac{\left\{\frac{(n-4)\,\rho_0^2}{E_n} - (n-1)\,(\rho^2-\rho_0^4)\right\}}{\frac{n-4}{E_n} + (n-1)\,(n-2)\,\rho_0^2 - n\,(n-1)\,(\rho^2-\rho_0^4)\,E_{n+1}} \quad \text{...(xliii)},$$

and $$(n-1)(1-\rho_0^4)E_n = (2n-3)\rho_0^2 + \frac{n-2}{E_{n-1}} \quad \text{.....(xliv).}$$

But even this would be laborious had we to find successive values of E_n from (xliv). Actually, if n be moderately large, E_n and E_{n-1} tend to equality fairly rapidly. For example the following are the values of E_n for $\rho_0 = \cdot 6$:

$$I_1 = 2\cdot 078{,}4173,\ I_2 = 1\cdot 873{,}8688 \text{ and therefore } E_2 = \cdot 901{,}5845.$$

E_2	·901,5845	E_9	1·470,8511	E_{16}	1·511,0031	E_{23}	1·527,2571
E_3	1·257,5588	E_{10}	1·475,5703	E_{17}	1·514,1874	E_{24}	1·528,7778
E_4	1·183,5106	E_{11}	1·486,5966	E_{18}	1·516,9985	E_{25}	1·530,1728
E_5	1·451,8703	E_{12}	1·492,1848	E_{19}	1·519,5018	E_{26}	1·531,4570
E_6	1·377,5430	E_{13}	1·498,5199	E_{20}	1·521,7436	E'	1·529,7263
E_7	1·453,2879	E_{14}	1·503,1022	E_{21}	1·523,7636	E''	1·531,0459
E_8	1·445,7342	E_{15}	1·507,3770	E_{22}	1·525,5928	E'''	1·530,1488

Clearly E_n and E_{n-1} approach equality. Now put $E_{25} = E_{24}$ for $n = 25$ in (xliv) and we have for $\rho_0 = \cdot 6$

$$20\cdot 8896E'^2 - 16\cdot 92E' - 23 = 0,$$

which gives for the root required

$$E' = 1\cdot 529{,}7263.$$

But we might also have made $E_{25} = E_{26}$ and so reached

$$21\cdot 7600E''^2 - 17\cdot 64E'' - 24 = 0,$$

which gives $$E'' = 1\cdot 531{,}0459.$$

It is better therefore in finding E_n to equate E_n and E_{n-1} than E_n and E_{n+1}.

A still closer approximation may be found by noting that

$$E_n - E' = \epsilon = E_{n+1} - E'', \text{ nearly,}$$

where ϵ is very small. Hence since

$$n(1-\rho_0^4)E_{n+1}E_n - (2n-1)\rho_0^2 E_n - (n-1) = 0,$$

we have

$$\epsilon = \frac{(n-1) + (2n-1)\rho_0^2 E' - n(1-\rho_0^4)E'E''}{n(1-\rho_0^4)(E'+E'') - (2n-1)\rho_0^2},$$

or, $$E''' = E' + \epsilon = \frac{(n-1) + n(1-\rho_0^4)E'^2}{n(1-\rho_0^4)(E'+E'') - (2n-1)\rho_0^2} \quad \text{.....(xlv).}$$

For the case of $\rho_0 = \cdot 6$ and $n = 25$ we find

$$E''' = 1\cdot 530{,}1488,$$

and $E_{25} - E''' = \cdot 000{,}0240$, a close agreement. As a matter of fact as we only use E_n in a small term the approximation E' is generally quite sufficient.

In the above method all turns on finding a good value of ρ_0^2, i.e. a first approximation to the value of the product of ρ and $\check{r}$. This may be obtained in either of the following ways:

First, choose the values of ρ_0^2 and E' to satisfy the simultaneous equations

$$\frac{(n-4)\,\rho_0^2}{E'} - (n-1)\,(\rho^2 - \rho_0^4) = 0,$$

and
$$(n-1)\,(1-\rho_0^4)\,E' = (2n-3)\,\rho_0^2 + \frac{n-2}{E'}$$

Or, we have for ρ_0 the equation

$$\frac{(n-1)\,(n-4)\,(1-\rho_0^4)\,\rho_0^2}{(n-1)\,(\rho^2-\rho_0^4)} = (2n-3)\,\rho_0^2 + \frac{(n-2)\,(n-1)\,(\rho^2-\rho_0^4)}{(n-4)\,\rho_0^2},$$

which writing $\rho_0^4 = z$ gives us

$$(n-4)^2\,(1-z)\,z = (2n-3)\,(n-4)\,z\,(\rho^2-z) + (n-2)\,(n-1)\,(\rho^2-z)^2,$$

or
$$6z^2 - z\,\{(n-4)^2 + \rho^2\,(5n-8)\} + (n-2)\,(n-1)\,\rho^4 = 0 \quad \text{.....(xlvi).}$$

As illustration if $n = 25$ and $\rho = \cdot 6$

$$6z^2 - 483\cdot 12z + 71\cdot 5392 = 0,$$

giving
$$z = \cdot 148{,}351,$$

or,
$$\rho_0^2 = \check{r}\rho = \cdot 385{,}164,$$

and
$$\check{r} = \cdot 64194,$$

a value* in excellent agreement with the results on p. 337, and needing no further approximation.

Again suppose $n = 5$, and $\rho = \cdot 6$, we have

$$6z^2 - 7\cdot 12z + 1\cdot 5552 = 0.$$

Hence $z = \cdot 288{,}6295$ and $\rho_0^2 = \cdot 537{,}2425$ leading to $\check{r} = \cdot 895{,}404$ as our approximation. We shall now use this value of ρ_0^2 to determine the true system of E's corresponding to this value.

We have
$$n\,(1-\rho_0^4)\,E_{n+1} = (2n-1)\,\rho_0^2 + \frac{n-1}{E_n},$$

while
$$E_2 = \rho_0^2 + \frac{1}{\sqrt{1-\rho_0^4}\cos^{-1}(-\rho_0^2)} \quad \text{.....(xlvii)}$$

$$= 1\cdot 091{,}8073.$$

Substituting in

$$n \times \cdot 711{,}3705 E_{n+1} = (2n-1) \times \cdot 537{,}2425 + \frac{n-1}{E_n},$$

we obtain the series

$$E_2 = 1\cdot 091{,}8073, \qquad E_3 = 1\cdot 776{,}5988,$$
$$E_4 = 1\cdot 786{,}2042, \qquad E_5 = 1\cdot 911{,}8858, \qquad E_6 = 1\cdot 947{,}6088.$$

The values show us that $E_5 = E_4$ was naturally much rougher in this case than that of $n = 25$. However we find $\epsilon = +\cdot 001{,}1177$, $\rho_0^2 = \cdot 538{,}3602$ and $\check{r} = \cdot 897{,}267$, as our next approximation, involving no very great change.

* Repeated use of Eqn. (xli) only modified this result to $\check{r} = \cdot 641{,}939$.

To confirm this value of $\check{r}$ we take as the first approximation to $\check{r}$ the value given in the method of the following section, i.e. $\check{r} = \cdot 91344$ giving $\rho_0^2 = \cdot 548{,}064$ and

$$n \times \cdot 699{,}6259 E_{n+1} = (2n-1) \times \cdot 548{,}0640 + \frac{n-1}{E_n}.$$

Using (xlvii) we find $E_2 = 1 \cdot 103{,}9149$ and hence

$$E_3 = 1 \cdot 822{,}4446, \qquad E_4 = 1 \cdot 828{,}4768,$$
$$E_5 = 1 \cdot 957{,}1738, \qquad E_6 = 1 \cdot 994{,}3056,$$

leading to $\epsilon = - \cdot 008{,}8172,$

and $\rho_0^2 = \cdot 539{,}2468,$

or $\check{r} = \cdot 89875.$

It will be seen that our two methods of approaching the true value of $\check{r}$ still differ to some extent, although probably serviceable enough for practical purposes. Accordingly we will now make a further approximation starting from $\check{r} = \cdot 8980$ or $\rho_0^2 = \cdot 5388$, and we have

$$E_2 = 1 \cdot 093{,}5399, \qquad E_3 = 1 \cdot 783{,}0638, \qquad E_4 = 1 \cdot 792{,}1629,$$
$$E_5 = 1 \cdot 918{,}2742, \qquad E_6 = 1 \cdot 954{,}1949.$$

These give $\epsilon = - \cdot 000{,}4924,$

and consequently $\rho_0^2 = \cdot 538{,}3036,$

with $\check{r} = \cdot 89717,$

a value no doubt correct to four figures.

It is clear that the process of finding the mode for n small is much more laborious than for $n = 25$ or over, because E_n is not nearly E_{n+1}. Actually the value given for E' by the simultaneous equation process from which we started is

$$E' = 1 \cdot 881{,}8787,$$

which is only a rough approximation to the value $E_5 = 1 \cdot 911{,}8858$. That method must therefore be followed by further approximations when n is much smaller than 25.

(5) *Determination of Ordinates and Mode by Expansions.*

Approximate Expression for the Ordinates. We may proceed to expand the Eqn. (xxxvii) in powers of $1/n$ or $1/(n-1)$. This will involve a knowledge of the expansion of

$$I_n = \int_0^\infty \frac{dz}{(\cosh z - \rho_0^2)^n}, \text{ where } \rho_0^2 = \rho\check{r},$$

and can be achieved by a process to which Pearson drew attention in 1902*.

Let $$\frac{1}{\cosh z - \rho_0^2} = \frac{1}{1-\rho_0^2} e^{-(a_2' z^2 + a_4' z^4 + a_6' z^6 + a_8' z^8 + \ldots)} \quad \ldots\ldots\ldots\text{(xlviii)}.$$

* *Biometrika*, Vol. I. p. 393.

Then, if

$$v = \log(\cosh z - \rho_0^2) = \log(1-\rho_0^2) + a_2' z^2 + a_4' z^4 + a_6' z^6 + \ldots,$$

it follows that

$$a_2' = \frac{1}{2!}\left(\frac{d^2v}{dz^2}\right)_0, \qquad a_4' = \frac{1}{4!}\left(\frac{d^4v}{dz^4}\right)_0,$$

and so on.

Now $$\frac{dv}{dz} = \frac{\sinh z}{\cosh z - \rho_0^2}, \quad \text{or} \quad (\cosh z - \rho_0^2)\frac{dv}{dz} = \sinh z.$$

Apply Leibnitz's Theorem, differentiating $(2s-1)$ times, and we have

$$\sinh z \frac{dv}{dz} + (2s-1)\cosh z \frac{d^2v}{dz^2} + \frac{(2s-1)(2s-2)}{2!}\sinh z \frac{d^3v}{dz^3} + \ldots + (\cosh z - \rho_0^2)\frac{d^{2s}v}{dz^{2s}} = \cosh z.$$

Hence when $z = 0$

$$(2s-1)\left(\frac{d^2v}{dz^2}\right)_0 + \frac{(2s-1)(2s-2)(2s-3)}{3!}\left(\frac{d^4v}{dz^4}\right)_0 + \ldots + (1-\rho_0^2)\left(\frac{d^{2s}v}{dz^{2s}}\right)_0 = 1.$$

Now put s in succession 1, 2, 3, etc. and there results

$$(1-\rho_0^2)\left(\frac{d^2v}{dz^2}\right)_0 = 1, \qquad 3\left(\frac{d^2v}{dz^2}\right)_0 + (1-\rho_0^2)\left(\frac{d^4v}{dz^4}\right)_0 = 1,$$

$$5\left(\frac{d^2v}{dz^2}\right)_0 + 10\left(\frac{d^4v}{dz^4}\right)_0 + (1-\rho_0^2)\left(\frac{d^6v}{dz^6}\right)_0 = 1.$$

$$7\left(\frac{d^2v}{dz^2}\right)_0 + 35\left(\frac{d^4v}{dz^4}\right)_0 + 21\left(\frac{d^6v}{dz^6}\right)_0 + (1-\rho_0^2)\left(\frac{d^8v}{dz^8}\right)_0 = 1,$$

$$9\left(\frac{d^2v}{dz^2}\right)_0 + 84\left(\frac{d^4v}{dz^4}\right)_0 + 126\left(\frac{d^6v}{dz^6}\right)_0 + 36\left(\frac{d^8v}{dz^8}\right)_0 + (1-\rho_0^2)\left(\frac{d^{10}v}{dz^{10}}\right)_0 = 1,$$

etc., etc.

These lead to

$$a_2' = \frac{1}{2}\frac{1}{1-\rho_0^2}, \qquad a_4' = -\frac{2+\rho_0^2}{24(1-\rho_0^2)^2},$$

$$a_6' = \frac{16 + 13\rho_0^2 + \rho_0^4}{720(1-\rho_0^2)^3}, \qquad a_8' = -\frac{(272 + 297\rho_0^2 + 60\rho_0^4 + \rho_0^6)}{40320(1-\rho_0^2)^4},$$

$$a_{10}' = \frac{7936 + 10841\rho_0^2 + 3651\rho_0^4 + 251\rho_0^6 + \rho_0^8}{3{,}628{,}800(1-\rho_0^2)^5}, \quad \text{etc.}$$

Accordingly we have, raising (xlviii) to the nth power and expanding the exponential after the term in $a_2' z^2$,

$$\frac{1}{(\cosh z - \rho_0^2)^n} = \frac{1}{(1-\rho_0^2)^n} e^{-na_2' z^2}\{1 - na_4' z^4 - na_6' z^6 - n(a_8' - \tfrac{1}{2}na_4'^2) z^8 - n(a_{10}' - na_4' a_6') z^{10} - n(a_{12}' - na_4' a_8' - \tfrac{1}{2}na_6'^2 + \tfrac{1}{6}n^2 a_4'^3) z^{12} + \ldots\}.$$

Remembering that

$$\int_{-\infty}^{+\infty} e^{-\frac{nz^2}{2(1-\rho_0^2)}} z^{2s} dz = \sqrt{2\pi}\sqrt{\frac{1-\rho_0^2}{n}}(2s-1)(2s-3)\dots 1 \times \frac{(1-\rho_0^2)^s}{n^s},$$

we find

$$I_n = \int_0^\infty \frac{dz}{(\cosh z - \rho_0^2)^n} = \frac{1}{2}\frac{\sqrt{2\pi}}{(1-\rho_0^2)^n}\sqrt{\frac{1-\rho_0^2}{n}}\left(1 + \frac{1}{8}\frac{\rho_0^2+2}{n} + \frac{1}{128}\frac{9\rho_0^4+12\rho_0^2+4}{n^2}\right.$$
$$+ \frac{75\rho_0^6+90\rho_0^4-20\rho_0^2-40}{1024n^3}$$
$$\left. + \frac{3675\rho_0^8+4200\rho_0^6-2520\rho_0^4-3360\rho_0^2-336}{32768n^4} + \text{etc.}\right) \quad \dots(\text{xlix}).$$

But $$y_n = \frac{(n-2)(1-\rho^2)^{\frac{n-1}{2}}(1-r^2)^{\frac{n-4}{2}}}{\pi} I_{n-1}, \quad \text{if} \quad \rho_0^2 = \rho r,$$

and thus we have

$$y_n = \frac{1}{\sqrt{2\pi}}\frac{n-2}{\sqrt{n-1}}(1-\rho^2)^{\frac{3}{2}}\chi_0(\rho, r)$$
$$\times\left(1 + \frac{\phi_1(\rho r)}{(n-1)} + \frac{\phi_2(\rho r)}{(n-1)^2} + \frac{\phi_3(\rho r)}{(n-1)^3} + \frac{\phi_4(\rho r)}{(n-1)^4} + \dots\right) \quad \dots(\text{l}),$$

where $$\chi_0(\rho, r) = \frac{(1-\rho^2)^{\frac{n-4}{2}}(1-r^2)^{\frac{n-4}{2}}}{(1-\rho r)^{n-\frac{3}{2}}}$$

is symmetrical in ρ and r and

$$\left.\begin{aligned} \phi_1(\rho r) &= \frac{r\rho+2}{8}, \qquad \phi_2(\rho r) = \frac{(3r\rho+2)^2}{128}, \\ \phi_3(\rho r) &= \frac{5\{15(r\rho)^3 + 18(r\rho)^2 - 4(r\rho) - 8\}}{1024}, \\ \phi_4(\rho r) &= \frac{3675(r\rho)^4 + 4200(r\rho)^3 - 2520(r\rho)^2 - 3360(r\rho) - 336}{32768} \end{aligned}\right\} \quad \dots(\text{li}),$$

thus depend only on the product of ρ and r.

We may write

$$y_n = \frac{n-2}{\sqrt{n-1}}(1-\rho^2)^{\frac{3}{2}}\chi(\rho, r)\left\{1 + \frac{\phi_1(\rho r)}{(n-1)} + \frac{\phi_2(\rho r)}{(n-1)^2} + \frac{\phi_3(\rho r)}{(n-1)^3} + \frac{\phi_4(\rho r)}{(n-1)^4} + \dots\right\}$$
$$\dots\dots\dots(\text{lii}),$$

where $$\log\chi(\rho, r) = -(n-1)\log\chi_1 - \log\chi_2,$$

and $$\chi_1 = \frac{1-\rho r}{\{(1-\rho^2)(1-r^2)\}^{\frac{1}{2}}},$$

$$\chi_2 = \frac{\sqrt{2\pi}\{(1-\rho^2)(1-r^2)\}^{\frac{3}{2}}}{(1-\rho r)^{\frac{1}{2}}},$$

both being symmetrical in r and ρ

Table C in Appendix gives the values of $\log \frac{n-2}{\sqrt{n-1}}$, $\log (1-\rho^2)^{\frac{3}{2}}$, $\log \chi_1$, $\log \chi_2$, ϕ_1, ϕ_2, ϕ_3, ϕ_4, and enables the ordinates of the frequency curves to be calculated with considerable rapidity for $n = 25$ and upwards*.

Approximate Expressions for the Mode.

Writing $$I_n' = \int_0^\infty \frac{dz}{(\cosh z - \rho\check{r})^n},$$

we find $$I_n' = \frac{1}{2}\frac{\sqrt{2\pi}}{(1-\rho\check{r})^n}\sqrt{\frac{1-\rho\check{r}}{n}}\left(1 + \frac{\phi_1'}{n} + \frac{\phi_2'}{n^2} + \frac{\phi_3'}{n^3} + \ldots\right),$$

where ϕ_s' stands for $\phi_s(\rho\check{r})$. We now use Eqn. (xxxix) and find

$$\frac{\check{r} - \rho\check{r}^2}{\rho - \rho\check{r}^2} = \frac{n-1}{n-4}\sqrt{\frac{n-1}{n}}\,R,$$

where

$$R = \left(1 + \frac{\phi_1'}{n} + \frac{\phi_2'}{n^2} + \frac{\phi_3'}{n^3} + \ldots\right)\Big/\left(1 + \frac{\phi_1'}{(n-1)} + \frac{\phi_2'}{(n-1)^2} + \frac{\phi_3'}{(n-1)^3} + \ldots\right) \quad \ldots\ldots\ldots\text{(liii)}.$$

If we expand this in inverse powers of $\frac{1}{n-1}$, we deduce

$$R = 1 - \frac{\phi_1'}{(n-1)^2} + \frac{\phi_1'^2 - 2\phi_2' + \phi_1'}{(n-1)^3} - \frac{\phi_1'^3 + \phi_1'^2 + \phi_1' - 3\phi_1'\phi_2' - 3\phi_2' + 3\phi_3'}{(n-1)^4} + \ldots.$$

Again

$$\frac{n-1}{n-4}\sqrt{\frac{n-1}{n}} = 1 + \frac{5}{2(n-1)} + \frac{63}{8(n-1)^2} + \frac{373}{16(n-1)^3} + \frac{8987}{128(n-1)^4} + \ldots.$$

Thus we have

$$\frac{\check{r} - \rho\check{r}^2}{\rho - \rho\check{r}^2} = 1 + \frac{5}{2(n-1)} + \frac{63 - \phi_1'}{8(n-1)^2} + \frac{373 - 24\phi_1' + 16\phi_1'^2 - 32\phi_2'}{16(n-1)^3}$$
$$+ \frac{8987 - 816\phi_1' + 192\phi_1'^2 - 128\phi_1'^3 + 384\phi_1'\phi_2' - 256\phi_2' - 384\phi_3'}{128(n-1)^4} + \ldots.$$

Bringing the first term on the right to the left we reach after substituting for the ϕ''s

$$\check{r} = \rho\left(1 + \frac{5}{2}\frac{(1-\check{r}^2)}{(n-1)} + \frac{(61 - \rho\check{r})(1-\check{r}^2)}{8(n-1)^2} + \frac{(367 - 5\rho\check{r} - 2\rho^2\check{r}^2)(1-\check{r}^2)}{16(n-1)^3}\right.$$
$$\left. + \frac{(17606 - 195\rho\check{r} - 81\rho^2\check{r}^2 - 50\rho^3\check{r}^3)(1-\check{r}^2)}{256(n-1)^4} + \ldots\right) \ldots\ldots\text{(liv)}.$$

* The ordinates calculated by the rising difference formula were tested in this manner. For $n = 25$ the accordance was excellent, and quite good enough for practical purposes at $n = 10$. Below this (lii) becomes less reliable and needs more terms.

This series has now to be inverted and leads after considerable algebra to

$$\check{r} = \rho\left(1 + \frac{5}{2}\frac{(1-\rho^2)}{(n-1)} + \frac{(61-101\rho^2)(1-\rho^2)}{8(n-1)^2} + \frac{(367-1480\rho^2+1273\rho^4)(1-\rho^2)}{16(n-1)^3} + \frac{(17606-125727\rho^2+246783\rho^4-143782\rho^6)(1-\rho^2)}{256(n-1)^4} + \ldots\right) \ldots\ldots\text{(lv)}.$$

The above series is of very considerable interest from more than one standpoint*. In the first place it appears that Soper's approximation (*Biometrika*, Vol. IX. p. 108) was not valid. He obtained

$$\check{r} = \rho\left\{1 + \frac{3}{2}\frac{(1-\rho^2)}{(n-1)} + \frac{(41+23\rho^2)(1-\rho^2)}{8(n-1)^2} + \ldots\right\}.$$

Thus for $n = 25$, $\rho = \cdot 6$, Soper's formula gives ·62811, and (lv) gives ·64205, while the exact value is ·64194. It is clear that the coefficient $\frac{3}{2}$ in Soper's second term of the series can never approach the $\frac{5}{2}$ of the more exact expression. At first the difference was found very perplexing, especially when the algebra had been verified; but the solution appears to lie in the consideration that the best fitting Pearson curve to the frequency is not one tied down to the range -1 to $+1$. That curve is fitted by two moments only, but if we fit a curve by the first four moments and use the general expression

$$\check{r} = \bar{r} + \frac{\sigma_r\sqrt{\beta_1}(\beta_2+3)}{2(5\beta_2-6\beta_1-9)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\text{(lvii)},$$

we obtain $\check{r} = \cdot 64192$,

a value close to the true value. In other words the use of the third and fourth moments to find the mode is far more important than fixing down the range to the theoretically possible values; that process determines much more quickly the form of the frequency curve, but it does not give nearly such a good fit as allowing the Pearson curve freedom to adjust itself by means solely of the first four moments†. On the other hand a Pearson curve determined by the first four moments does describe fairly accurately the frequency distributions of r for $n = 25$ and upwards: see p. 337.

(6) *Equation for Modes and Antimodes* ($n = 3$).

Still another method of approaching the modal value has been found occasionally of service‡.

* We have used the expansion in terms of $1/(n-1)$ rather than $1/n$ as $(n-1)$ appears to arise more simply in all the formulae. The form in $1/n$ is

$$\check{r} = \left(1 + \frac{5(1-\rho^2)}{2n} + \frac{(81-101\rho^2)(1-\rho^2)}{8n^2} + \frac{(651-1884\rho^2+1273\rho^4)(1-\rho^2)}{16n^3} + \ldots\right) \ldots\text{(lvi)}.$$

† The Pearson curve determined from the range does not give good values of the frequency for $n = 25$, even when we use the true values of $\bar{r}$ and σ_r and not Soper's approximations to these constants.

‡ It was used successfully in calculating the antimode in the case of samples of three, when the correlation in the sampled population was low. It gave a fairly good "jumping off point" even for higher values of the correlation.

Starting from the equation (xxxix)

$$(n-4)\,\check{\rho}^2 I_{n-1} = (\rho^2 - \check{\rho}^4)\,(n-1)\,I_n,$$

where $I_n = \int_0^\infty \frac{dz}{(\cosh z - \check{\rho}^2)^{n-1}}$ and $\check{\rho}^2 = \rho\check{r}$, $\check{r}$ being the modal value of r, we may expand I_n and I_{n-1} in terms of powers of $\check{\rho}^2$, the coefficients involving

$$\int_0^\infty \frac{dz}{(\cosh z)^{m-1}} = \int_0^{\frac{\pi}{2}} \sin^{m-1}\theta\, d\theta = q_m.$$

We find at once

$$(n-4)\,\check{\rho}^2\Big(q_{n-1} + (n-1)\,\check{\rho}^2 q_n + \frac{(n-1)\,n}{1\,.\,2}\,\check{\rho}^4 q_{n+1} + \frac{(n-1)\,n\,(n+1)}{1\,.\,2\,.\,3}\,\check{\rho}^6 q_{n+2} + \ldots\ldots\Big)$$
$$= (\rho^2 - \check{\rho}^4)\,(n-1)\Big(q_n + n\check{\rho}^2 q_{n+1} + \frac{n\,(n+1)}{1\,.\,2}\,\check{\rho}^4 q_{n+2} + \frac{n\,(n+1)\,(n+2)}{1\,.\,2\,.\,3}\,\check{\rho}^6 q_{n+3} + \ldots\ldots\Big).$$

Rearranging and substituting $\rho\check{r}$ for $\check{\rho}^2$ and noting that

$$q_{m+1} = \frac{m-1}{m}\,q_{m-1},$$

we have

$$\rho\,(n-1)\,q_n = \check{r}q_{n-1}\,(n-4-\rho^2\,(n-1)^2) + \tfrac{1}{2}(n-1)\,\check{r}^2\rho q_n\,(2\,(n-3) - \rho^2 n^2) + \frac{(n-1)\,n}{6}\,\check{r}^3\rho^2 q_{n+1}\,(3\,(n-2) - \rho^2\,(n+1)^2) + \text{etc.} \ldots\ldots\text{(lviii)},$$

where the form of the successive terms is sufficiently obvious, and the series converges rapidly if ρ be small.

For the particular case in which we have chiefly used this equation to determine $\check{r}$, namely samples of three, $\check{r}$ corresponds to an antimode and the equation is for $n = 3$:

$$2\rho q_3 = -\check{r}q_2\,(1 + 4\rho^2) - \check{r}^2 q_3 9\rho^3 + \check{r}^3 q_4\rho^2\,(3 - 16\rho^2) + \check{r}^4 q_5\rho^3\,(8 - 25\rho^2) + \check{r}^5 q_6\rho^4\,(15 - 36\rho^2) + \check{r}^6 q_7\rho^5\,(24 - 49\rho^2) + \check{r}^7 q_8\rho^6\,(35 - 64\rho^2) + \text{etc.} \ldots\ldots\text{(lix)}.$$

An equation which led to $\check{r}$ with singular accuracy and comparative ease for small values of ρ by aid of Table X for q_n.

(7) *Tables and Models.*

Table A (p. 379) gives the values of the mean, of the mode, of the standard deviation, of β_1 and β_2 and thus of the skewness of the frequency distributions of r. It will be seen that long after we have reached the limit of what are usually treated as small samples, the skewness of the distribution of r is very considerable. The

approach to the normal curve is very slow, and the "probable error of the correlation coefficient," i.e. $\cdot 67449\,(1-r^2)/\sqrt{n}$ as usually recorded, has very little worth. Models have been prepared to illustrate these points as follows:

Model A gives for $n = 2$ to $n = 25$, the distribution of r for $\rho = \cdot 6$.

Model B gives for $n = 2$ to $n = 25$, the distribution of r for $\rho = \cdot 8$.

Model C gives for $n = 3$, the distribution of r for $\rho = 0$ to $\cdot 9$.

Model D gives for $n = 4$, the distribution of r for $\rho = 0$ to $\cdot 9$.

Model E gives for $n = 25$, the distribution of r for $\rho = 0$ to $\cdot 9$.

Model F gives for $n = 50$, the distribution of r for $\rho = 0$ to $\cdot 9$.

(Further models are in process of construction for low values of n.)

Even the photographs of such models form a striking warning of the dangers which arise (i) from small samples, and (ii) from judging results from even repeated small samples; the modal value of the frequency distribution for the correlation of these will be very sensibly higher than the correlation of the sampled population.

(8) *On the Determination of the "most likely" Value of the Correlation in the Sampled Population,* i.e. $\hat{\rho}$.

We now turn to another point. Suppose we have found the value of the correlation in a small sample to be r, what is the most reasonable value $\hat{\rho}$ to give to the correlation ρ of the sampled population?

Now we know that

$$y_n = (n-2)\frac{(1-\rho^2)^{\frac{n-1}{2}}}{\pi}(1-r^2)^{\frac{n-4}{2}}\int_0^\infty \frac{dz}{(\cosh z - \rho r)^{n-1}},$$

and if $\phi(\rho)\,d\rho$ were the law of distribution of ρ's, we ought to make

$$\frac{n-2}{\pi}(1-\rho^2)^{\frac{n-1}{2}}\,\phi(\rho)\,(1-r^2)^{\frac{n-4}{2}}\int_0^\infty \frac{dz}{(\cosh z - \rho r)^{n-1}}\,d\rho$$

a maximum with ρ, or in other words deduce the value of ρ for a given r from

$$\frac{d}{d\rho}\left\{\int_0^\infty \frac{(1-\rho^2)^{\frac{n-1}{2}}\,\phi(\rho)\,dz}{(\cosh z - \rho r)^{n-1}}\right\} = 0 \quad \text{.....(lx).}$$

Fisher puts $\phi(\rho)$ equal to a constant and then differentiating out reaches the equation

$$\int_0^\infty \frac{(r - \rho\cosh z)\,dz}{(\cosh z - \rho r)^n} = 0 \text{.....(lxi),}$$

which should provide the value of ρ in terms of r. He solves this only to a first approximation, obtaining,

$$\rho = r\left(1 - \frac{1-r^2}{2n}\right) \quad \text{.....(lxii).}$$

This is a lower approximation than Soper's second approximation, in similar cases, and we know that even Soper's values are not sufficiently accurate when n is as large as 25. Hence no very great confidence can be put in (lxii).

But there is another point about (lx) which is of great importance. Fisher's equation, our (lxi), is deduced on the assumption that $\phi(\rho)$ is constant. In other words he assumes a horizontal frequency curve for ρ, or holds that *à priori* all values of ρ are equally likely to occur. This raises a number of philosophical points and difficulties. We ask:

When we are in absolute ignorance as to ρ, is it according to our experience that all values of the correlation are equally likely to occur? We think this question must probably if not certainly be answered in the negative. Very high correlations are relatively rare, and most biometricians would find it difficult to cite straight away a couple of cases of the correlation equal to $-\cdot 95$ although they could cite a score in which the correlation was sensibly zero, or again about $\cdot 5$. Every biometrician is seeking high correlations, for these are for him the all important data, but he knows how difficult and rare they are to find*. The equal distribution of ignorance which applies so well to many statistical ratios, does not seem valid in the case of correlations†. We generally know quite approximately

* We have recently had occasion to table (*a*) nearly 400 correlations between characters of the human femur, and (*b*) over 300 for characters of the human skull. The distributions were very far indeed from horizontal straight lines, and to suppose *à priori* such distributions horizontal could only lead to grave errors.

† A similar problem arises in the case of standard deviations. If Σ be the S.D. of the sample and σ of the sampled population, then the frequency curve for S.D.'s is (*Biometrika*, Vol. X. p. 523)

$$y = y_0 \frac{\Sigma^{n-2}}{\sigma^{n-1}} e^{-\frac{1}{2}\frac{n\Sigma^2}{\sigma^2}}$$

Now, if we make this a maximum for variation of σ, we obtain

$$\sigma = \sqrt{\frac{n}{n-1}}\,\Sigma \qquad \ldots\ldots(\alpha)$$

as the "best value" of σ.

This was pointed out to the Editor by "Student," and was a desirable criticism of the statement made (Vol. X. pp. 528–9) that the most reasonable value to give to Σ was the mode of the sampled population, i.e. to take the observed $\Sigma = \check{\Sigma} = \sqrt{\frac{n-2}{n}}\,\sigma$ or suppose

$$\sigma = \sqrt{\frac{n}{n-2}}\,\Sigma \qquad \ldots\ldots(\beta).$$

Equations (α) and (β) are not identical. But again (α) is based on the assumption that *all* values of the S.D. are *à priori* equally likely to occur. But surely this is not a result in accordance with our experience! Values of σ from 0 to ∞ are not equally within our experience, and there is almost an absurdity in talking about a standard deviation varying from 0 to ∞; are we to include all possible scales in this distribution? The S.D. of stature might certainly be anything from practically zero to infinity if we measured it first in "light years" and then in microns. Or, are we to measure our S.D.'s all in the same units, when we suppose the distribution of S.D.'s to be of equal probability from zero to infinity? How is this to be done in the case of an absolute length and an index? Given a definite problem, there is certainly no *à priori* likelihood that the S.D. will have every value from 0 to ∞, if we confine ourselves to one scale. It must practically be less than the mean value, and in most actual

the correlation of the characters in the population samples, and desire to ascertain whether a small sample of some population *similar to a known population* confirms our experience.

For example, we may have twenty pairs of brothers recorded for some special character. Our *à priori* knowledge is certainly not that all correlations between pairs of brothers from -1 to $+1$ are equally likely to occur! On the contrary we anticipate a value which will not be very far from 0·5. And this *à priori* conviction is so great, that if the small sample did not give a value which considering the size of the sample was compatible with the correlation in the sampled population being near 0·5, we should suspect errors in the measurement or some form of disturbing selection. In such cases, and something like them appears to us most frequent in biometric practice, it is we think erroneous to apply Bayes' Theorem. All it seems possible to do is to assume that we have drawn a value near the mode of our distribution, for our sampled population is much more likely to have a single value, that of our *à priori* experience, than every possible value from -1 to $+1$. If Bayes' Theorem confirms this value—so much the better; if it does not, its fundamental hypothesis is usually so unjustified that it seems most unreasonable to assert that it must give the most likely value of the correlation in the sampled population.

The fuller solution of Eqn. (lxi) thus appears to have academic rather than practical value. Still certain points of theoretical interest arise in the discussion of both (lx) and (lxi). Let us suppose that our *à priori* knowledge consists in the distribution of ρ about a mean $\bar{\rho}$ with a standard deviation κ. It is convenient to take $\kappa^2 = m(1-\bar{\rho}^2)$, where m is an arbitrary constant. Probably $\kappa = 0$, whenever $\bar{\rho} = 1$, and this suggested this form; but since m is quite arbitrary we lay no stress on this point. The equation to determine the most likely value of ρ now becomes

$$\frac{d}{d\rho}\int_0^\infty \frac{(1-\rho^2)^{\frac{n-1}{2}}\, e^{-\frac{(\rho-\bar{\rho})^2}{2m(1-\bar{\rho})^2}}}{(\cosh z - \rho r)^{n-1}}\, dz = 0,$$

or

$$\frac{(\rho-\bar{\rho})(1-\rho^2)}{m(n-1)(1-\bar{\rho}^2)} I_{n-1} + \rho I_{n-1} = (1-\rho^2) r I_n \quad \text{.....(lxiii).}$$

Now this equation cannot in general be solved unless we know the order of the product $m(n-1)$. Certain cases, however, can be considered. If m be very large, i.e. if there be very considerable scatter in our past experience of ρ, then

$$\rho I_{n-1} = (1-\rho^2) r I_n \text{.....(lxiv),}$$

problems is very narrowly limited. For example we measure twenty individuals of a population for stature, and seek the best value of the variability of the sampled population from the result. Would it not be unreasonable to suppose that *à priori* this variability may be equally likely to have any value from 0 to ∞ ? Our *à priori* knowledge is that it is somewhere between 2″·5 and 3″·0 and very far from equally likely even between these values. To justify the equal distribution of our ignorance, we should have to assume that we neither knew the exact character measured, nor the unit in which it was measured, and such ignorance can only be very exceptional in the present state of our knowledge.

an equation identical with what we obtain by the "equal distribution of our ignorance." The same result is also reached if m be only moderately large and n very big. In other words "the equal distribution of our ignorance," even if we really have some knowledge of the frequency distribution of ρ, will not lead us badly astray in the case of big samples. The matter is quite otherwise, however, in the case of *small* samples; unless our knowledge is very limited (m very large) we have no right whatever to take (lxiv) as applying to such small samples. Indeed when m is fairly small ρ will not differ substantially from $\bar{\rho}$, and the solution of (lxiii) will differ widely from that of (lxiv). We may consider these cases in succession.

Case (i). *Very slight knowledge of ρ, or on the other hand a large sample.*

Here we are justified in using (lxiv). We can attempt its solution in two different ways as in the case of the mode.

Let $\hat{\rho}$ be the most likely value of ρ and let us write $\hat{\rho}r = \rho_1^2$, then

$$(1 - \hat{\rho}^2)\, r\hat{I}_n = \hat{\rho}\hat{I}_{n-1},$$

or

$$(r^2 - \rho_1^4)\, \hat{I}_n = \rho_1^2 \hat{I}_{n-1}.$$

Now let ρ_0^2 be a first approximation to ρ_1^2 and suppose $\rho_1^2 = \rho_0^2 + \epsilon$, where ϵ is small. Then

$$(r^2 - \rho_0^4 - 2\rho_0^2\epsilon)\,(I_n' + n\epsilon I'_{n+1}) = (\rho_0^2 + \epsilon)\,(I'_{n-1} + \overline{n-1}\,\epsilon I_n'),$$

where

$$I_n' = \int_0^\infty \frac{dz}{(\cosh z - \rho_0^2)^n}.$$

Hence remembering that

$$n\,(1 - \rho_0^4)\, I'_{n+1} = (2n-1)\,\rho_0^2 I_n' + (n-1)\, I'_{n-1},$$

we find

$$\epsilon = \frac{I_n'\,(r^2 - \rho_0^4) - \rho_0^2 I'_{n-1}}{I'_{n-1} + \rho_0^2\,(n+1)\, I_n' - n\,(r^2 - \rho_0^4)\, I'_{n+1}},$$

or

$$\epsilon = (1 - \rho_0^4)\frac{(r^2 - \rho_0^4)\, E_n - \rho_0^2}{(1-\rho_0^4) - (n-1)(r^2 - \rho_0^4) + \rho_0^2\{(n+1)(1-\rho_0^4) - (2n-1)(r^2 - \rho_0^4)\}E_n} \quad \text{.....(lxv),}$$

where

$$(1 - \rho_0^4)\,(n-1)\, E_n = (2n-3)\,\rho_0^2 + \frac{n-2}{E_{n-1}} \quad \text{.....(lxvi),}$$

and

$$E_n = I_n'/I'_{n-1}.$$

Now (lxv) and (lxvi) may be treated exactly like the corresponding equations for the determination of the mode. If n be moderately large, we may put

$$E_n = E_{n-1} = E'$$

in (lxv), and if we know ρ_0^2 obtain the value of E', which value substituted for E_n in (lxvi) gives us ϵ and thus a new approximation. If we cannot guess a good value for ρ_0^2 (although $\rho_0^2 = \rho^2$ is in this case usually sufficient) we can treat the

numerator of (lxv) equated to zero, and (lxvi) with E' for E_n and E_{n-1} as simultaneous equations to find E' and ρ_0^2, and so obtain a good approximation straight off, when n is of the order 25, or a fair first approximation when n is smaller.

Applying this we have from (lxv)

$$E_n = E_{n-1} = \rho_0^2/(r^2 - \rho_0^4).$$

Hence

$$(n-1)(1-\rho_0^4)\rho_0^4 - (2n-3)\rho_0^4(r^2-\rho_0^4) - (n-2)(r^2-\rho_0^4)^2 = 0,$$

or

$$\rho_0^2 = r^2\sqrt{\frac{n-2}{n-1-r^2}},$$

and therefore

$$\hat{\rho} = r \times \sqrt{\frac{n-2}{n-1-r^2}} \quad \text{.....(lxvii).}$$

Thus it will be seen that on the hypothesis of the equal distribution of ignorance for $n = 100$, the ratio of $\hat{\rho}$ to r will differ less than ·99402 from unity. On the other hand if n be 5, the ratio of $\hat{\rho}$ to r may differ from unity by as much as ·8660 does. For example, if $n = 5$, then $\hat{\rho} = ·26278$ if $r = ·3$. But for a sample of five the standard deviation of a value of ρ between ·2 and ·3 is of the order ·18 to ·20, so that there is little to be gained by treating the observed ·30 as corresponding to a sampled population of ·26.

We shall now proceed to determine an expansion for $\hat{\rho}$. If R be the ratio of Eqn. (liii), we find from (lxiv)

$$\hat{\rho} = r(1-\hat{\rho}^2)\hat{I}_n/\hat{I}_{n-1},$$

or

$$\hat{\rho} = \frac{r(1-\hat{\rho}^2)}{1-\hat{\rho}r}\sqrt{\frac{n-1}{n}}\,R$$

$$= \frac{r(1-\hat{\rho}^2)}{1-\hat{\rho}r}\left(1+\frac{1}{n-1}\right)^{-\frac{1}{2}}\left(1-\frac{\phi_1}{(n-1)^2}+\frac{\phi_1^2-2\phi_2+\phi_1}{(n-1)^3}+\ldots\right),$$

whence on substituting

$$\hat{\rho} = r\left(1-\frac{1}{2}\frac{1-\hat{\rho}^2}{n-1}+\frac{1}{8}\frac{(1-r\hat{\rho})(1-\hat{\rho}^2)}{(n-1)^2}+\frac{1}{16}\frac{(1+r\hat{\rho}-2r^2\hat{\rho}^2)(1-\hat{\rho}^2)}{(n-1)^3}+\ldots\right),$$

and after inversion

$$\hat{\rho} = r\left(1-\frac{1}{2}\frac{1-r^2}{n-1}+\frac{(1-5r^2)(1-r^2)}{8(n-1)^2}+\frac{(1+8r^2-17r^4)(1-r^2)}{16(n-1)^3}+\ldots\right)$$

.....(lxviii).

This result gives us a measure of the correctness of (lxvii), for that equation may be written

$$\hat{\rho} = r\left(\frac{1-\dfrac{1}{n-1}}{1-\dfrac{r^2}{n-1}}\right)^{\frac{1}{2}}$$

$$= r\left\{1-\frac{(1-r^2)}{2(n-1)}-\frac{(1+3r^2)(1-r^2)}{8(n-1)^2}-\frac{(1+2r^2+5r^4)(1-r^2)}{16(n-1)^3}+\ldots\right\} \quad \text{(lxix).}$$

Thus the divergence begins as early as the term in $1/(n-1)^2$ and (lxvii) can only be trusted for rough approximations to $\hat{\rho}$.

Illustration. Suppose $r = \cdot 6$, what is the "most likely" value of ρ, on the assumption of equal distribution of ignorance? Let $n = 25$, then we find from (lxviii)

$$\hat{\rho} = \cdot 59194,$$

while (lxvii) gives ·59182, an agreement adequate for most statistical purposes.

If $n = 5$, and $r = \cdot 6$, we find

$$\hat{\rho} = \cdot 55058 \text{ from (lxviii)},$$
$$= \cdot 56695 \text{ from (lxvii)}.$$

There is now considerable divergence in the two methods and another approximation is desirable. Let us take $\rho_0^2 = \hat{\rho} r = \cdot 33035$, then to find E_n we have

$$(n-1) \times \cdot 890{,}8689 E_n = (2n-3) \times \cdot 33035 + \frac{n-2}{E_{n-1}}$$

E_2 will be given by (xlvii) and equals ·885,5939, whence we determine

$$E_3 = 1 \cdot 189{,}9819, \quad E_4 = 1 \cdot 246{,}8946, \quad E_5 = 1 \cdot 324{,}1082,$$

and accordingly from (lxv)

$$\epsilon = \cdot 001{,}3081,$$

$$r\hat{\rho} = \rho_0^2 + \epsilon = \cdot 331{,}8581,$$

and $\hat{\rho} = \cdot 553{,}097$, a value not far removed from that found by the first approximation. We conclude that even when n is small, quite good results will be found from (lxviii) and that it is probably better to use this rather than (lxvii) in such cases as the starting point for a second approximation.

Case (ii). *Close à priori Knowledge of* ρ.

We will now suppose m small, so that the first approximation to ρ may be taken as $\bar{\rho}$. We substitute in (lxiii) $\rho = \bar{\rho} + \psi$ and we find, neglecting squares of ψ,

$$\left(\frac{\psi}{m(n-1)} + \bar{\rho} + \psi\right)(\bar{I}_{n-1} + (n-1) r\psi \bar{I}_n) = (1 - \bar{\rho}^2 - 2\bar{\rho}\psi)(r\bar{I}_n + nr\psi \bar{I}_{n+1}),$$

where

$$\bar{I}_n = \int_0^\infty \frac{dz}{(\cosh z - \bar{\rho} r)^{n-1}}.$$

This leads us to

$$\psi = \frac{(1-\bar{\rho}^2) r\bar{I}_n - \bar{\rho}\bar{I}_{n-1}}{\bar{I}_{n-1}\left(1 + \frac{1}{m(n-1)}\right) + \bar{\rho}(n+1) r\bar{I}_n - (1-\bar{\rho}^2) nr^2 \bar{I}_{n+1}},$$

whence remembering that

$$n(1 - (r\bar{\rho})^2)\bar{I}_{n+1} = (2n-1) r\bar{\rho}\bar{I}_n + (n-1)\bar{I}_{n-1},$$

and writing $\bar{E}_n = \bar{I}_n/\bar{I}_{n-1}$, we have after some transformations

$$\hat{\rho} = \bar{\rho} + \psi$$
$$\doteq \bar{\rho} + \frac{(1-r^2\bar{\rho}^2)\,((1-\bar{\rho}^2)\,r\bar{E}_n - \bar{\rho})}{(1-r^2\bar{\rho}^2)\left(1+\frac{1}{m\,(n-1)}\right) - (n-1)\,r^2\,(1-\bar{\rho}^2) + r\bar{\rho}\,\{(n+1)(1-r^2\bar{\rho}^2) - (2n-1)r^2\,(1-\bar{\rho}^2)\}\,\bar{E}_n} \quad \ldots\ldots\ldots\ldots\text{(lxx)},$$

where
$$(n-1)\,(1-r^2\bar{\rho}^2)\,\bar{E}_n = (rn-3)\,r\bar{\rho} + \frac{n-2}{\bar{E}_{n-1}} \quad \ldots\ldots\ldots\ldots\text{(lxxi)}.$$

The method is now straightforward, at least for n moderately large. We put $\bar{E}_n = \bar{E}_{n-1} = \bar{E}'$ in (lxxi) and substitute the resulting value of $\bar{E}'$ for $\bar{E}_n$ in (lxx), and thus reach the small correction on $\bar{\rho}$.

Illustration. In a sample of 25 pairs only of parent and child the correlation for a certain character was found to be ·6. What is the most reasonable value to give to ρ in the sampled population?

If we distributed our ignorance equally the result would be that stated on p. 357, i.e.

$$\hat{\rho} = \cdot 59194.$$

But, in applying Bayes' Theorem to this case, to what result of experience do we appeal? Clearly the only result of experience by which we could justify this "equal distribution of ignorance" would be the accumulative experience that in past series the correlation of parent and child had taken with equal frequency of occurrence every value from -1 to $+1$. To appeal to such a result is absurd; Bayes' Theorem ought only to be used where we have in past experience, as for example in the case of probabilities and other statistical ratios, met with every admissible value with roughly equal frequency. There is no such experience in this case. On the contrary the mean value of ρ for very long series of frequencies of 1000 and upwards is known to be $+$ ·46 and the range is hardly more than ·40 to ·52. We may accordingly take $\bar{\rho} = \cdot 46$ and $m\,(1-\bar{\rho}^2) = \kappa^2 =$ about ·0004, whence

$$m = \cdot 0004/\cdot 7884 = \cdot 000{,}507 \text{ say.}$$

Thus $\dfrac{1}{m\,(n-1)} = 82\cdot 1828$ and the term containing it is the dominating term in Equation (lxiii). Thus $\hat{\rho}$ will differ little from $\bar{\rho}$. We find

$$\hat{\rho} = \bar{\rho} + \frac{\cdot 437{,}006\bar{E}_n - \cdot 424{,}959}{70\cdot 034{,}491 + 2\cdot 790{,}925\bar{E}_n},$$

from (lxx).

We next determine $\bar{E}_n = \bar{E}'$ from (lxxi), i.e.

$$24 \times \cdot 923{,}824\bar{E}'^2 - 47 \times \cdot 276\bar{E}' - 23 = 0,$$

which gives us $\bar{E}' = 1\cdot 352{,}2185$, thus $\psi = \cdot 00225$ and

$$\hat{\rho} = \cdot 46225,$$

a totally different "most likely value" from that obtained by "equally distributing our ignorance."

Statistical workers cannot be too often reminded that there is no validity in a mathematical theory pure and simple. Bayes' Theorem must be based on experience, the experience that where we are *à priori* in ignorance all values are equally likely to occur. This is not the case in the present illustration, and we must use our past experience in the same way as we should use our past experience of equal frequency; the appeal to this experience has here absolutely the same validity as in Bayes' case and cannot be for a moment neglected. We see that our new experience scarcely modifies the old and this is what we should naturally conjecture would be the case. If we increase the size of the new sample, then ultimately $1/m\,(n-1)$ becomes very small, and we approach nearer the value ·59194 given by Bayes' Theorem. But past experience will bias the value obtained from the new material for a long time, and we see that according to the value of the past experience $\hat{\rho}$ may vary from ·46225 to ·59194. It will thus be evident that in problems like the present the indiscriminate use of Bayes' Theorem is to be deprecated. It has unfortunately been made into a fetish by certain purely mathematical writers on the theory of probability, who have not adequately appreciated the limits of Edgeworth's justification of the theorem by appeal to *general* experience.

Case (iii). *Past Experience a Factor, but not the Dominating Factor of Judgment.*

Cases can arise in which $\rho = \bar{\rho}$ is not a very close approximation, i.e. when we have some past experience, but not a very concentrated one of like correlations. In this case we must return to Equation (lxiii), and we shall assume $\hat{\rho}r = \rho_0^2 + \epsilon$, where ρ_0^2 is some fairly close approximation to $\hat{\rho}r$. We shall write $\bar{\rho}r = \bar{\rho}_0^2$. We find

$$\epsilon = \frac{(r^2-\rho_0^4)\,I_n - \left\{\rho_0^2 + \dfrac{(\rho_0^2-\bar{\rho}_0^2)\,(r^2-\rho_0^4)}{m\,(n-1)\,(r^2-\bar{\rho}_0^4)}\right\} I_{n-1}}{\left\{1+\dfrac{r^2+2\rho_0^2\bar{\rho}_0^2-3\rho_0^4}{m(n-1)(r^2-\bar{\rho}_0^4)}\right\} I_{n-1} + \left\{(n+1)\,\rho_0^2 + \dfrac{(\rho_0^2-\bar{\rho}_0^2)\,(r^2-\rho_0^4)}{m\,(r^2-\bar{\rho}_0^4)}\right\} I_n - n\,(r^2-\rho_0^4)\,I_{n+1}} \quad \text{.....(lxxii),}$$

where $$n\,(1-\rho_0^4)\,I_{n+1} = (2n-1)\,\rho_0^2 I_n + (n-1)\,I_{n-1} \quad \text{.....(lxxiii),}$$

equations which can be readily expressed in terms of E's.

Unfortunately the approximation obtained by equating the numerator of ϵ to zero and using (lxxiii) as simultaneous equations is not very rapidly obtained as the resulting equation is now of the eighth order. It is better from the data themselves to guess a reasonable value for ρ_0^2 and start the approximation from this.

Illustration. The correlation between the maximum length and breadth of crania is not very definitely known. Its mean is about ·30, but the values determined for it range from nearly zero to ·6. Assuming the standard deviation to be ·1, what is the "most likely value" to give to this correlation in the case of a sample of 25 skulls showing a correlation of ·50?

Here $\bar{\rho} = \cdot 30$, $m(1 - \bar{\rho}^2) = \cdot 01$, and $n = 25$. $\bar{\rho}_0{}^2 = r\bar{\rho} = \cdot 15$. We will assume as a first approximation to $\hat{\rho}$, $\hat{\rho} = \cdot 40$, hence $\rho_0{}^2 = \cdot 20$. Equation (lxxiii) for $n = n - 1$ gives

$$(n-1) \times \cdot 96 E_n = (2n-3) \times \cdot 20 + (n-2)/E_{n-1}.$$

Put $n = 25$, and $E' = E_n = E_{n-1}$, and we have to find E',

$$23 \cdot 04 E'^2 - 9 \cdot 4 E' - 23 = 0,$$

which gives $E' = 1 \cdot 223{,}7367$; from this we deduce $E_{n+1} = 1 \cdot 225{,}5025$, and

$$\epsilon = - \cdot 029{,}9238,$$

leading to $r\hat{\rho} = \cdot 170{,}0762$, or $\hat{\rho} = \cdot 34015$.

Starting again with $\rho_0{}^2 = \cdot 17008$, we find

$$23 \cdot 305{,}7472 E'^2 - 7 \cdot 99376 E' - 23 = 0,$$

giving $E' = 1 \cdot 179{,}6109$ and $E_{n+1} = 1 \cdot 181{,}3579$.

Whence we deduce $\epsilon = + \cdot 003{,}999$,

and accordingly $r\hat{\rho} = \cdot 174{,}079$ and $\hat{\rho} = \cdot 34816$, a close enough approximation.

But if we had "equally distributed our ignorance" we should have found*

$$\hat{\rho} = \cdot 49217.$$

These results seem extremely suggestive. If we were to observe the correlation of length and breadth of skull in a new sample of 25 skulls, then an observed value of ·50 would give a "most likely value" on the equal distribution of ignorance of ·4922.

But no biometrician would admit absolute ignorance in such a case; the correlation has been determined rather vaguely and not very adequately so that results range from something like zero to ·6. But this *à priori* knowledge leads on precisely the same basis as Bayes' Theorem to the value $\hat{\rho} = \cdot 3482$—a result very much closer to previous experience of the mean value, than to the observed result. And there are relatively few cases in which some such, if only vague, *à priori* experience does not exist.

In the light of the above illustrations we consider it justifiable to assert that the results deduced from the principle of the "equal distribution of ignorance" have academic rather than practical value, and we hold that to apply it without consideration of its basis to the problem of finding the most likely values of the statistical constants of a sampled population from the values observed in a small sample may lead to results very wide from the truth.

(9) *Special Cases of Frequency for n small.*

We shall now discuss individually the lowest sample sizes.

(i) *Samples of Two, n = 2.* Here

$$\bar{r} = \frac{\sin^{-1}\rho}{\frac{1}{2}\pi},$$

* Equation (lxvii) would give $\hat{\rho} = \cdot 49204$, nearly as good practically as (lxviii)

and the distribution consists of $\frac{\cos^{-1}(-\rho)}{\pi}$ at $r = +1$ and $\frac{\cos^{-1}\rho}{\pi}$ at $r = -1$*, or at what is the same thing $\frac{1}{2}(1+\bar{r})$ and $\frac{1}{2}(1-\bar{r})$.

The moments are

$$\mu_1' = \mu_3' = \bar{r}, \qquad \mu_2' = \mu_4' = 1,$$

and accordingly

$$\mu_2 = 1 - \bar{r}^2, \qquad \mu_3 = -2\bar{r}(1-\bar{r}^2), \qquad \mu_4 = (1-\bar{r}^2)(1+3\bar{r}^2) \ldots \text{(lxxiv)}.$$

Hence $\beta_1 = 4\bar{r}^2/(1-\bar{r}^2), \qquad \beta_2 = (1+3\bar{r}^2)/(1-\bar{r}^2),$

and accordingly $$\beta_2 - \beta_1 - 1 = 0.$$

TABLE I. *Samples of Two.*

ρ, value of correlation in sampled population	$\bar{r}$, mean correlation of samples	σ_r	β_1	β_2	Number of positive correlations per 1000 samples	Number of negative correlations per 1000 samples
0·0	0	1	0	1	500·000	500·000
0·1	·063,7686	·997,965	·016,332	1·016,332	531·884	468·116
0·2	·128,1884	·991,750	·066,827	1·066,827	564·094	435·906
0·3	·193,9734	·981,007	·156,387	1·156,387	596·987	403·013
0·4	·261,9798	·965,007	·294,764	1·294,764	630·990	369·010
0·5	·333,3333	·942,809	·500,000	1·500,000	666·667	333·333
0·6	·409,6655	·912,236	·806,686	1·806,686	704·833	295·167
0·7	·493,6334	·869,670	1·288,724	2·288,724	746·817	253·183
0·8	·590,3345	·807,164	2·139,534	3·139,534	795·167	204·833
0·9	·712,8674	·701,299	4·133,056	5·133,056	856·434	143·566
1·0	1·000,0000	·000,000	∞	∞	1,000·000	·000,000

The distributions are two lumps given by the last two columns, and are accurately given by Pearson's skew frequency distributions for the relation $\beta_2 - \beta_1 - 1 = 0$ (see *Phil. Trans.* Vol. 216 A, p. 433).

(ii) *Samples of Three,* $n = 3$.

$$y_3 = N\frac{1-\rho^2}{\pi}\frac{1}{\sqrt{1-r^2}}\frac{dU}{dx},$$

where $x = r\rho$ and $U = \cos^{-1}(-x)/\sqrt{1-x^2}$

as before. Hence

$$\mu_p' = \int_{-1}^{+1} r^p y_3 dr = \frac{1}{\rho^{p+1}}\int_{-\rho}^{+\rho} x^p y_3 dx$$

$$= \frac{\rho(1-\rho^2)}{\pi\rho^{p+1}}\int_{-\rho}^{+\rho}\frac{x^p}{\sqrt{\rho^2-x^2}}\frac{dU}{dx}dx.$$

* Since we can determine at sight whether any pair is positively or negatively correlated, this gives a method of determining ρ by simply counting the number of + 1 and − 1 correlations in the arrays, say m_p and m_n, then $\rho = \cos\pi\left(\frac{m_n}{m_n + m_p}\right)$ and the probable error of the determination is

$$\frac{\cdot 67449}{\sqrt{N}}\sqrt{1-\rho^2}\sqrt{\frac{m_n}{N}\left(1-\frac{m_n}{N}\right)},$$

N being the number of pairs used. Cf. "Student," *Biometrika*, Vol. VI. p. 304.

Now let $x = \rho \sin \phi$, then

$$\mu_p' = \frac{1-\rho^2}{\pi} \int_{-\frac{\pi}{2}}^{+\frac{\pi}{2}} \sin^p \phi \frac{dU}{dx} d\phi.$$

Now
$$\sin \phi \frac{dU}{dx} = \frac{dU}{d\rho},$$

hence
$$\mu_p' = \frac{1-\rho^2}{\pi} \int_{-\frac{\pi}{2}}^{+\frac{\pi}{2}} \sin^{p-1} \phi \frac{dU}{d\rho} d\phi$$

$$= \frac{1-\rho^2}{\pi} \frac{d}{d\rho} \int_{-\frac{\pi}{2}}^{+\frac{\pi}{2}} \sin^{p-1} \phi U d\phi.$$

But
$$U = \int_0^\infty \frac{dz}{\cosh z - \rho \sin \phi},$$

thus
$$\mu_p' = \frac{1-\rho^2}{\pi} \frac{d}{d\rho} \int_0^\infty dz \int_{-\frac{\pi}{2}}^{+\frac{\pi}{2}} \frac{\sin^{p-1} \phi}{\cosh z - \rho \sin \phi} d\phi \ldots.$$

Write
$$\psi = \frac{\pi}{2} + \phi \quad \text{and} \quad \cosh z = \eta,$$

we have
$$\mu_p' = \frac{1-\rho^2}{\pi} \frac{d}{d\rho} \int_0^\infty dz \int_0^\pi \frac{(-1)^{p-1} \cos^{p-1} \psi d\psi}{\eta + \rho \cos \psi} \quad \ldots\ldots\ldots\ldots (\text{lxxv}).$$

Let $p = 1$, then we find

$$\mu_1' = \frac{2(1-\rho^2)}{\pi} \frac{d}{d\rho} \int_0^\infty dz \int_0^\pi \frac{d(\tan \frac{1}{2}\psi)}{(\eta+\rho) + (\eta-\rho)\tan^2 \frac{1}{2}\psi}.$$

But

$$\int_0^\pi \frac{d(\tan \frac{1}{2}\psi)}{(\eta+\rho) + (\eta-\rho)\tan^2 \frac{1}{2}\psi} = \left[\frac{1}{\sqrt{\eta^2-\rho^2}} \tan^{-1} \left(\frac{\tan \frac{1}{2}\psi}{\sqrt{\frac{\eta+\rho}{\eta-\rho}}} \right) \right]_0^\pi = \frac{\pi}{2} \frac{1}{\sqrt{\eta^2-\rho^2}}.$$

Thus
$$\mu_1' = (1-\rho^2) \frac{d}{d\rho} \int_0^\infty \frac{dz}{\sqrt{\eta^2-\rho^2}}.$$

Now take
$$\eta = \frac{1}{\sin \phi'} = \cosh z,$$

hence
$$-\frac{\cos \phi'}{\sin^2 \phi'} d\phi' = \sinh z dz,$$

$$= \sqrt{\eta^2 - 1}\, dz,$$

thus
$$dz = -\operatorname{cosec} \phi' d\phi'.$$

It follows that
$$\mu_1' = (1-\rho^2) \frac{d}{d\rho} \int_0^{\frac{\pi}{2}} \frac{d\phi'}{\sqrt{1-\rho^2 \sin^2 \phi'}}.$$

Let as usual $$F\left(k, \frac{\pi}{2}\right) = \int_0^{\frac{\pi}{2}} \frac{d\phi}{\sqrt{1 - k^2 \sin^2 \phi}},$$

and $$E\left(k, \frac{\pi}{2}\right) = \int_0^{\frac{\pi}{2}} \sqrt{1 - k^2 \sin^2 \phi}\, d\phi.$$

Then we have $$\mu_1' = (1 - \rho^2) \frac{dF\left(\rho, \frac{\pi}{2}\right)}{d\rho}.$$

But $$\frac{dF_1}{dk} = \frac{1}{kk'^2}(E_1 - k'^2 F_1),$$

where $$k' = \sqrt{1 - k^2},$$

E_1 and F_1 denoting the complete elliptic integrals*.

Thus finally

$$\bar{r} = \frac{1}{\rho}\{E_1 - (1 - \rho^2) F_1\} \quad \text{.....(lxxvi),}$$

and $\bar{r}$ is known, as soon as ρ is given, from tables of the complete elliptic integrals.

Returning to Equation (xx) and putting $n = 3$ we have

$$\begin{aligned}\mu_2' &= 1 - \frac{1}{2}(1 - \rho^2)\left(1 + \frac{\rho^2}{2} + \frac{\rho^4}{3} + \frac{\rho^6}{4} + \frac{\rho^8}{5} + \ldots\right) \\ &= 1 + \frac{1}{2}\frac{1 - \rho^2}{\rho^2}\left\{-\rho^2 - \frac{1}{2}(\rho^2)^2 - \frac{1}{3}(\rho^2)^3 - \frac{1}{4}(\rho^2)^4 - \ldots\right\} \\ &= 1 + \frac{1}{2}\frac{1 - \rho^2}{\rho^2}\log_e(1 - \rho^2) \quad \text{.....(lxxvii),}\end{aligned}$$

and further

$$\sigma_r^2 = \mu_2 = 1 - \bar{r}^2 + \frac{1}{2}\frac{1 - \rho^2}{\rho^2}\log_e(1 - \rho^2) \quad \text{.....(lxxviii).}$$

We now turn to the third moment and may anticipate a recurrence of the elliptic integrals. We shall obtain our result on the whole most briefly by appealing to Equations (xxii) and (xxiii) on pp. 335 and 336. We have

$$\mu_3' = \chi_1 - \chi_3 = \frac{\rho(1 - \rho^2)}{2}\left\{I_3 \cdot F\left(\frac{3}{2}, \frac{3}{2}, 2, \rho^2\right) - \frac{1}{3} I_5 \cdot F\left(\frac{3}{2}, \frac{3}{2}, 3, \rho^2\right)\right\},$$

or since $$I_3 = \frac{\pi}{2}, \quad I_5 = \frac{3}{4}\frac{\pi}{2},$$

$$\begin{aligned}\mu_3' &= \frac{\rho(1 - \rho^2)}{2}\frac{\pi}{2}\left\{F\left(\frac{3}{2}, \frac{3}{2}, 2, \rho^2\right) - \frac{1}{4}F\left(\frac{3}{2}, \frac{3}{2}, 3, \rho^2\right)\right\} \\ &= \frac{\rho(1 - \rho^2)}{2}\frac{\pi}{2}\left\{S\left[\frac{(3 \cdot 5 \ldots 2s + 1)^2}{2^{2s}(s)!\,(s + 1)!}\rho^{2s}\right] - \frac{1}{2}S\left[\frac{(3 \cdot 5 \ldots 2s + 1)^2}{2^{2s}(s)!\,(s + 2)!}\rho^{2s}\right]\right\} \\ &= \frac{\rho(1 - \rho^2)}{2}\frac{\pi}{2}\left\{S\left[\frac{(3 \cdot 5 \ldots 2s + 1)^2}{2^{2s}(s)!\,(s + 1)!}\left(1 - \frac{1}{2s + 4}\right)\rho^{2s}\right]\right\}\end{aligned}$$

* Cayley, *Elementary Treatise on Elliptic Functions*, p. 48.

$$= \frac{\rho(1-\rho^2)}{2}\frac{\pi}{2}\left\{S\left[\frac{(3.5\ldots 2s+3)^2}{2.2^{2s}(s+2)!\,(s+2)!}\frac{(s+1)(s+2)}{2s+3}\rho^{2s}\right]\right\}$$

$$= \frac{(1-\rho^2)}{2\rho^2}\frac{\pi}{2}\frac{d}{d\rho}\left\{S\left[\frac{(3.5\ldots 2s+3)^2}{2^{2s}(s+2)!\,(s+2)!}\frac{s+1}{2s+3}\frac{\rho^{2s+4}}{2^2}\right]\right\}$$

$$= \frac{1-\rho^2}{\rho^2}\frac{d}{d\rho}\left\{\frac{\pi}{2}S\left[\frac{(3.5\ldots 2s+3)^2}{2^4.2^{2s}(s+2)!\,(s+2)!}\left(1-\frac{1}{2s+3}\right)\rho^{2s+4}\right]\right\}$$

$$= \frac{1-\rho^2}{\rho^2}\frac{d}{d\rho}\left\{\frac{\pi}{2}F\left(\frac{1}{2},\ \frac{1}{2},\ 1,\ \rho^2\right)+\frac{\pi}{2}F\left(-\frac{1}{2},\ \frac{1}{2},\ 1,\ \rho^2\right)\right\}$$

$$= \frac{1-\rho^2}{\rho^2}\frac{d}{d\rho}\{F_1(\rho)+E_1(\rho)\}$$

$$= \frac{1-\rho^2}{\rho^2}\left\{\frac{E_1-(1-\rho^2)F_1}{\rho(1-\rho^2)}+\frac{E_1-F_1}{\rho}\right\},$$

or

$$\mu_3' = \frac{2-\rho^2}{\rho^3}E_1 - \frac{2(1-\rho^2)}{\rho^3}F_1 \quad \text{.....(lxxix),}$$

where E_1 and F_1 are as before the complete elliptic integrals.

In order to obtain the fourth moment coefficient about zero we will return to formulae (xx) and (xxi) of pp. 334–5 and write

$$\mu_2' = 1 - \frac{n-2}{n-1}(1-\rho^2)f_2$$

and

$$\mu_4' = 2\mu_2' - 1 + \frac{n(n-2)}{(n+1)(n-1)}(1-\rho^2)^2 f_4,$$

where f_2 and f_4 are the hypergeometrical series.

Now the general term of f_2 is

$$\frac{(2.4.6.8\ldots 2s+2)^2\rho^{2s+2}}{(s+1)!\,(n+1)(n+3)\ldots(n+2s+1)\,2^{s+1}},$$

and the general term of f_4 is

$$\frac{(4.6.8\ldots 2s+2)^2\rho^{2s}}{(s)!\,(n+3)(n+5)\ldots(n+2s+1)\,2^s}.$$

Hence it follows that

$$\frac{n+1}{4\rho}\frac{df_2}{d\rho} = f_4,$$

or we have

$$\mu_4' = 1 - \frac{2(n-2)}{n-1}(1-\rho^2)f_2 + \frac{n(n-2)}{4(n-1)}(1-\rho^2)^2\frac{df_2}{\rho d\rho} \quad \text{.....(lxxx).}$$

Thus if we are able to sum f_2 algebraically, we can determine μ_4' algebraically*

* The corresponding formula for μ_3' and $\mu_1' = \bar{r}$ is

$$\mu_3' = \bar{r} - (1-\rho^2)(n-2)\frac{d}{d\rho}\left(\frac{\bar{r}}{\rho}\right) \quad \text{.....(lxxxi).}$$

If we put $n = 3$ and $\bar{r} = \frac{1}{\rho}(E_1 - (1-\rho^2)F_1)$ we find

$$\mu_3' = \frac{2-\rho^2}{\rho^3}E_1 - \frac{2(1-\rho^2)}{\rho^3}F_1$$

confirming the result in Eqn. (lxxix).

Putting $n=3$ and writing $f_2 = -\frac{1}{\rho^2}\log_e(1-\rho^2)$, we have

$$\mu_4' = 1 + \frac{1-\rho^2}{\rho^2}\log_e(1-\rho^2) - \frac{3}{8}\frac{(1-\rho^2)^2}{\rho}\frac{d}{d\rho}\left\{\frac{\log_e(1-\rho^2)}{\rho^2}\right\}$$

$$= 1 + \frac{1-\rho^2}{4\rho^4}\{3\rho^2 + (3+\rho^2)\log_e(1-\rho^2)\} \quad \text{.....(lxxxii).}$$

This completes the moment coefficients for samples of three.

As ρ may be determined by considering the ratio of negative to positive correlations in samples of two, so it may be determined by considering the ratio of positive to negative correlations in samples of three. Let m_p be the number of positive and m_n the number of negative correlations, then since

$$y_3 = N\frac{1-\rho^2}{\pi}\frac{1}{\sqrt{1-r^2}}\frac{1}{r}\frac{dU}{d\rho},$$

$$m_p = \frac{1-\rho^2}{\pi}\frac{d}{d\rho}\int_0^{+1}\frac{U dr}{r\sqrt{1-r^2}}$$

$$= \frac{1-\rho^2}{\pi}\frac{d}{d\rho}\int_0^{+1}\frac{\cos^{-1}(-\rho r)\,dr}{r\sqrt{(1-r^2)(1-r^2\rho^2)}}$$

and

$$m_n = \frac{1-\rho^2}{\pi}\frac{d}{d\rho}\int_{-1}^{0}\frac{\cos^{-1}(-\rho r)\,dr}{r\sqrt{(1-r^2)(1-r^2\rho^2)}}.$$

Now put in the latter integral $r = -r$, then

$$m_n = \frac{1-\rho^2}{\pi}\frac{d}{d\rho}\int_0^{+1}\frac{-\cos^{-1}(\rho r)\,dr}{r\sqrt{(1-r^2)(1-r^2\rho^2)}}.$$

But $\cos^{-1}(-\rho r) + \cos^{-1}(\rho r) = \pi$, hence

$$\frac{m_p - m_n}{m_p + m_n} = (1-\rho^2)\frac{d}{d\rho}\int_0^{+1}\frac{dr}{r\sqrt{(1-r^2)(1-r^2\rho^2)}}$$

$$= (1-\rho^2)\int_0^1\frac{r^2\rho\,dr}{\sqrt{1-r^2}(1-r^2\rho^2)^{\frac{3}{2}}},$$

or if $r = \sin\phi$,

$$= (1-\rho^2)\int_0^{\frac{\pi}{2}}\frac{\rho\sin\phi\,d\phi}{(1-\rho^2\sin^2\phi)^{\frac{3}{2}}}$$

$$= -(1-\rho^2)\int_0^{\frac{\pi}{2}}\frac{d(\rho\cos\phi)}{(1-\rho^2+\rho^2\cos^2\phi)^{\frac{3}{2}}}.$$

Or again if $\rho\cos\phi = \sqrt{1-\rho^2}\tan\theta$,

$$\frac{m_p - m_n}{m_p + m_n} = +(1-\rho^2)\int_0^{\sin^{-1}\rho}\frac{\sqrt{1-\rho^2}\cos^3\theta}{(1-\rho^2)^{\frac{3}{2}}}\frac{d\theta}{\cos^2\theta}$$

$$= \int_0^{\sin^{-1}\rho}\cos\theta\,d\theta = \rho,$$

or $$\rho = (m_p - m_n)/(m_p + m_n) \quad \text{.....(lxxxiii),}$$

a very simple formula if m_p or m_n has been found.

Clearly $$\rho = (2m_p - N)\, N,$$

and $$\delta\rho = 2\delta m_p/N,$$

$$\sigma_\rho^2 = 4\sigma^2_{m_p} = 4\,\frac{m_p}{N^2}\left(1 - \frac{m_p}{N}\right).$$

Thus the probable error of ρ found in this manner is

$$\frac{\cdot 67449}{\sqrt{N}}\, 2\sqrt{\frac{m_p}{N}\left(1 - \frac{m_p}{N}\right)} \quad \text{.....(lxxxiv),}$$

and can easily be evaluated, for it gives:

$$\text{Probable Error of } \rho = \frac{\cdot 67449}{\sqrt{N}}\sqrt{1 - \rho^2} \quad \text{.....(lxxxv).}$$

We see it is larger by the factor $\dfrac{1}{\sqrt{1-\rho^2}}$, which is greater than unity, than the usual value for the product moment process of the correlation. But a new point arises: N is the number of triplets in the present process, and N the number of individuals in the product moment process. If we take M triplets and N individuals, we have to compare

$$\cdot 67449\sqrt{1-\rho^2}/\sqrt{M} \quad \text{with} \quad \cdot 67449\,(1-\rho^2)/\sqrt{N},$$

and these probable errors will be equal if

$$M = N/(1-\rho^2).$$

If the number of triplets be $> N/(1-\rho^2)$ the triplet process will be more accurate than the product moment method. The number of triplets required for equality of probable errors are for the various values of ρ:

$\rho = 0$	$M = N$,	$\rho = \cdot 5$	$M = 1{\cdot}333N$,
$\rho = \cdot 1$	$M = 1{\cdot}010N$,	$\rho = \cdot 6$	$M = 1{\cdot}563N$,
$\rho = \cdot 2$	$M = 1{\cdot}042N$,	$\rho = \cdot 7$	$M = 1{\cdot}923N$,
$\rho = \cdot 3$	$M = 1{\cdot}099N$,	$\rho = \cdot 8$	$M = 2{\cdot}778N$,
$\rho = \cdot 4$	$M = 1{\cdot}190N$,	$\rho = \cdot 9$	$M = 5{\cdot}263N$.

This series would seem to suggest, since a triplet contains three individuals, that to use the triplet process with equal exactness with the product moment process, in the case, say, of $\rho = \cdot 5$, we should need a population of $4N$. But this assumes that each triplet is based upon three independent individuals. Actually a population of N provides $\frac{1}{6}N\,(N-1)\,(N-2)$ triplets and if these could be considered as an *independent* sample of M triplets, we should have a less value of the probable error of ρ by the triplet process using all possible sets than by the product moment process, provided

$$\rho^2 < 1 - \frac{6}{(N-1)\,(N-2)}.$$

For example if $N = 10$, for all values of ρ between + ·957 and − ·957, the 120 triplets will give a better result than the 10 individuals. Even 50 triplets would be better than 10 individuals for all values of ρ between + ·894 and − ·894. But the question arises whether we can consider the 120 triplets from a sample of 10 individuals as much a random sample as 120 triplets from an indefinitely large population, and this can hardly be the case. It may be, however, that 50 triplets out of the 120 would be sufficiently independent to give a better result than 10 individuals. It is very desirable that a full study should be made of such restricted sampling, for without such study it is not possible to assert how far the probable errors of doublet or triplet procedure are greater than those of the product moment method.

Of course in such a case as that referred to, the labour of the triplet process will be considerably greater, for we have to determine the *sign* of the correlation in 50 or 120 cases, instead of applying the product moment process to 10 individuals, and the labour rapidly increases with increase in the size of the set (doublet, triplet, etc.) and the size of the sample. Still the labour may be worth while in the case of small populations, where the best result is of considerable importance. We have not endeavoured to extend the theory to quadruplets or quintettes, because the labour of determining the sign of the correlation in these cases is very considerable.

In the case of triplets, we require the sign of the product moment

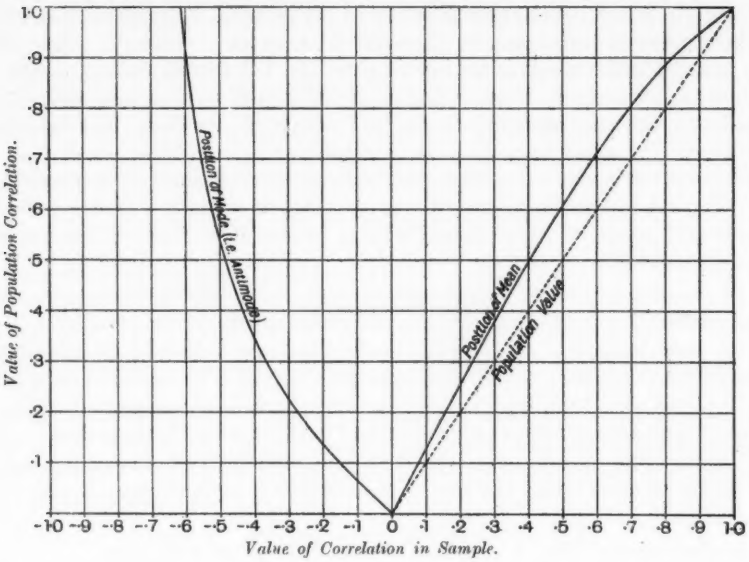
$$\frac{x_1y_1 + x_2y_2 + x_3y_3}{3} - \frac{(x_1 + x_2 + x_3)(y_1 + y_2 + y_3)}{9},$$

or the sign of $(x_2 - x_1)(y_2 - \bar{y}) + (x_3 - x_1)(y_3 - \bar{y})$.

Now suppose the triplet arranged according to the character x in ascending order x_1, x_2, x_3, then $x_2 - x_1$ and $x_3 - x_1$ will always be positive, and accordingly if either both $y_2 - \bar{y}$ and $y_3 - \bar{y}$ are positive, or both negative the sign of the correlation is obvious. On the other hand if $y_2 - \bar{y}$ and $y_3 - \bar{y}$ are of *opposite* sign, the matter has got to be a little more carefully considered. But if $\bar{y}$ has been found and the above differences determined, in most cases it is not needful to actually multiply out, in order to realise the sign. A graphic process depending on the plotting of the triplet triangle seemed on the whole more laborious than the above.

Of course in samples of three the U-shaped distributions give a minimum where $dy/dr = 0$, and we have therefore an *antimode*, not a mode. The values of this antimode are recorded in Table II, p. 368. It will be seen that all the antimodes are negative for positive correlations in the sampled population. The antimode asymptotes to the value − ·613,9616, which it reaches when $\rho = +1$. In this case the value actually fails at $\rho = +1$, for the equation $dy/dr = 0$ is satisfied then for all values of r, owing to the presence of the factor $(1 - \rho^2)^{\frac{n-1}{2}}$: see Equation (xxxvii). Nevertheless the antimode curve goes right up to the point indicated above and this value must be used for the purpose of interpolation

FIG. 2. Mode (Antimode) and Mean Curves for $n=3$, and for values of ρ from 0 to +1.



between $\rho = \cdot 95$ and $\rho = 1 \cdot 00$. The curve is shown in Fig. 2, and both antimodal and mean lines on the photograph of the model of the frequency surface.

The distributions are after $\rho = \cdot 2$ very skew U-shaped frequency curves, whose β_1, β_2 lie in the U-area of Pearson's skew curves, which, however, do not reproduce the antimode very closely. The ordinates are given in Table A (p. 379).

TABLE II. *Samples of Three.*

ρ, value of correlation in sampled population	$\bar{r}$, mean correlation of samples	$\dot{r}$, antimode of samples	σ_r	β_1	β_2	Number of positive correlations per 1000 samples	Number of negative correlations per 1000 samples
0·0	·0000,0000	·000,0000	·707,1068	·000,0000	1·500,0000	500	500
0·1	·0786,3836	−·151,2541	·704,5029	·028,0136	1·532,3082	550	450
0·2	·1578,7706	−·275,5141	·696,5708	·115,2406	1·632,9424	600	400
0·3	·2383,6407	−·367,9037	·682,9273	·272,2374	1·814,1763	650	350
0·4	·3208,5431	−·435,4082	·662,8536	·520,5707	2·101,1480	700	300
0·5	·4062,9889	−·485,5321	·635,1363	·901,7817	2·542,3242	750	250
0·6	·4960,0160	−·523,8811	·597,7313	1·500,1840	3·236,2938	800	200
0·7	·5919,3885	−·553,8751	·546,9866	2·510,5375	4·411,4204	850	150
0·8	·6975,5118	−·577,9216	·475,4818	4·503,0667	6·738,8238	900	100
0·9	·8204,3635	−·597,5916	·363,4654	10·222,6204	13·467,2160	950	50
0·95	·8742,5455	−·606,1358	·268,4676	21·078,0376	26·340,9890	975	25
1·00	1·0000,0000	−·613,9616	·000,0000	∞	∞	1,000	0

(iii) *Samples of Four,* $n = 4$.

Here, if $x = r\rho$,

$$y_4 = \frac{N(1-\rho^2)^{\frac{3}{2}}}{\pi}\frac{d^2}{dx^2}\left(\frac{\cos^{-1}(-x)}{\sqrt{1-x^2}}\right);$$

and if $$U = \cos^{-1}(-x)/\sqrt{1-x^2},$$

then $$\mu_q' = \frac{(1-\rho^2)^{\frac{3}{2}}}{\pi\rho^{q+1}}\left\{\left[x^q\frac{dU}{dx} - qx^{q-1}U\right]_{-\rho}^{+\rho} + q(q-1)\int_{-\rho}^{+\rho}x^{q-2}U\,dx\right\}.$$

To find the first four moments about $r = 0$, we have to determine

$$\int_{-\rho}^{+\rho}x^2U dx, \qquad \int_{-\rho}^{+\rho}xU\,dx, \qquad \int_{-\rho}^{+\rho}U\,dx,$$

$$x^4\frac{dU}{dx} - 4x^3U, \quad x^3\frac{dU}{dx} - 3x^2U, \quad x^2\frac{dU}{dx} - 2xU \quad \text{and} \quad x\frac{dU}{dx} - U.$$

The results are most briefly expressed by using Fisher's notation $\rho = \sin\alpha$ and remembering that

$$\cos^{-1}(-\rho) + \cos^{-1}(\rho) = \pi, \quad \text{and} \quad \alpha = \cos^{-1}(-\rho) - \frac{\pi}{2}.$$

For the purposes of integration we put $x = -\cos\theta$ and integrate in terms of θ. We find

$$\int_{-\rho}^{+\rho}x^2U\,dx = \tfrac{1}{2}\pi\{\alpha - \cos\alpha\sin\alpha\},$$

$$\int_{-\rho}^{+\rho}xU\,dx = 2\{\sin\alpha - \alpha\cos\alpha\},$$

$$\int_{-\rho}^{+\rho}U\,dx = \pi\alpha,$$

$$x^4\frac{dU}{dx} - 4x^3U = \pi\left\{\frac{\sin^5\alpha}{\cos^3\alpha} - 4\frac{\sin^3\alpha}{\cos\alpha}\right\},$$

$$x^3\frac{dU}{dx} - 3x^2U = 2\left\{\frac{\sin^3\alpha}{\cos^2\alpha} + \alpha\frac{\sin^4\alpha}{\cos^3\alpha} - 3\alpha\frac{\sin^2\alpha}{\cos\alpha}\right\},$$

$$x^2\frac{dU}{dx} - 2xU = \pi\left\{\frac{\sin^3\alpha}{\cos^3\alpha} - 2\frac{\sin\alpha}{\cos\alpha}\right\},$$

$$x\frac{dU}{dx} - U = 2\left\{\frac{\sin\alpha}{\cos^2\alpha} + \alpha\frac{\sin^2\alpha}{\cos^3\alpha} - \alpha\frac{1}{\cos\alpha}\right\}.$$

Hence substituting in the several values of μ_q', we obtain*

$$\bar{r} = \mu_1' = \frac{2}{\pi}\{\cot\alpha + \alpha(1 - \cot^2\alpha)\} \ldots\ldots\ldots\

$$\sigma_r^2 + \bar{r}^2 = \mu_2' = 1 - 2\cot^2\alpha + 2\alpha\cot^3\alpha \quad \text{.....(lxxxvii),}$$

$$\mu_3' = \frac{2}{\pi}\{\cot\alpha + 6\cot^3\alpha + \alpha(1 - 3\cot^2\alpha - 6\cot^4\alpha)\}$$

$$\text{.....(lxxxviii),}$$

$$\mu_4' = 1 - 4\cot^2\alpha - 6\cot^4\alpha + \alpha(6\cot^3\alpha + 6\cot^5\alpha)^*$$

$$\text{.....(lxxxix).}$$

From these formulae were calculated the values given in the following table.

TABLE III. *Samples of Four.*

ρ, value of correlation of sampled population	$\bar{r}$, mean value of correlation in samples	μ_3, 3rd moment coefficient	σ_r	Usual value assumed for σ_r, i.e. $\frac{1-\rho^2}{\sqrt{n-1}}$	β_1	β_2	β_2/β_1
0·0	0	0	·577,3503	·577,3503	0	1·800,000	∞
0·1	·084,9678	−·033,6268	·574,5653	·571,5768	·031,429	1·839,929	58·5418
0·2	·170,4532	−·065,2863	·566,0965	·554,2563	·129,510	1·964,665	15·1700
0·3	·257,0089	−·092,9620	·551,5835	·525,3887	·306,862	2·190,708	7·1391
0·4	·345,2652	−·114,5383	·530,3576	·484,9742	·589,510	2·552,205	4·3294
0·5	·435,9911	−·127,7520	·501,3081	·433,0127	1·028,270	3·116,256	3·0306
0·6	·530,1976	−·130,1567	·462,6087	·369,5042	1·728,423	4·022,982	2·3275
0·7	·629,3378	−·119,1407	·411,1087	·294,4486	2·940,226	5·609,288	1·9078
0·8	·735,7362	−·092,1708	·340,7311	·207,8461	5·428,946	8·922,221	1·6435
0·9	·853,9806	−·048,1281	·236,6586	·109,6966	13·184,043	19·571,006	1·4844
0·95	·920,8889	−·021,4678	·157,7942	·056,2917	29·8558	43·4082	1·4539
0·98	·965,7599	−·006,4363	·088,2666	·022,8631	87·5994	130·1935	1·4862
0·99	·982,1321	−·002,4358	·055,4859	·011,4893	203·3250	311·7316	1·5332
1·00	1	0	0	0	∞	∞	1·8305†

* These expressions cannot be applied to the case of $\rho = 0$. We must return to Equation (ix) and put $\rho = 0$, finding $y_4 = \frac{1}{2}N$ or a horizontal line.

† The ratio β_2/β_1 equals in the limit $(27\pi^2 - 256)(3\pi^2 - 16)/(9\pi^2 - 80)^2 = 1{\cdot}8305$. This may be shown by putting $\alpha = \frac{1}{2}\pi - \epsilon$, or $\rho = 1 - \frac{1}{2}\epsilon^2$, or $\epsilon = \sqrt{1-\rho^2}$, where ϵ is small. We then find for values of ρ near unity

$$\bar{r} = \rho^2 - \frac{8}{3\pi}(1-\rho^2)^{\frac{3}{2}}, \qquad \mu_2 = \left(\pi - \frac{16}{3\pi}\right)(1-\rho^2)^{\frac{3}{2}},$$

$$\mu_3 = -\left(3\pi - \frac{80}{3\pi}\right)(1-\rho^2)^{\frac{5}{2}}, \quad \mu_4 = \left(9\pi - \frac{256}{3\pi}\right)(1-\rho^2)^{\frac{5}{2}}.$$

These lead to

$$\beta_1 = \frac{\left(3\pi - \frac{80}{3\pi}\right)^2}{\left(\pi - \frac{16}{3\pi}\right)^3(1-\rho^2)^{\frac{3}{2}}}, \qquad \beta_2 = \frac{\left(9\pi - \frac{256}{3\pi}\right)}{\left(\pi - \frac{16}{3\pi}\right)^2(1-\rho^2)^{\frac{3}{2}}},$$

and give the above result.

(iv) *General Case of small Samples, $n > 4$.*

Equations (xxviii), (xxxi), (xxxii), and (xxxiv) enable us to express the moment-coefficients of a sample of $n + 2$ in terms of those of a sample of n. But we have found algebraic expressions for the moment-coefficients for $n = 3$ and $n = 4$ in terms of (a) the complete elliptic integrals and logarithmic functions, (b) trigonometrical functions of α and $\cot \alpha$. Hence all even samples can have their moment-coefficients expressed in terms of α and $\cot \alpha$, and all odd samples can have their odd moment-coefficients expressed in terms of the complete elliptic integrals and their even moments in terms of logarithmic functions. The former result has been already noticed by Fisher*. The arithmetical calculation of the successive moment-coefficients after $n = 4$ by the difference formulae is, however, shorter than obtaining the algebraical expressions and then substituting arithmetical values, and has been followed in our calculations.

(10) *Approach of the Distribution as n increases to a Normal Character.*

It is well known that for the "probable error" to have meaning the distribution must approach the Gaussian for which $\beta_1 = 0$, $\beta_2 = 3$. It is clear that these conditions are by no means fulfilled for samples of 25 or 50, whatever be the value of ρ. There is nearer approach in the *low* values of ρ in samples of 100, but there is considerable deviation for $\rho = 5$ and upwards.

TABLE IV. *Values of the Frequency Constants for the Correlation in Samples of 25.*

ρ	$\bar{r}$ mean	Actual $\check{r}$† mode	$\check{r}$ from Pearson's formula‡	Actual σ	$\frac{1-\rho^2}{\sqrt{n-1}}$	β_1	β_2
0·0	0	0	0	·2041,241	·2041,241	0	2·769,2305
0·1	·0979,577	·11173	·11127	·2022,954	·2020,829	·012,3106	2·791,6002
0·2	·1960,288	·22258	·22177	·1967,883	·1959,592	·049,8655	2·860,0511
0·3	·2943,287	·33172	·33090	·1875,386	·1857,530	·114,6242	2·978,8302
0·4	·3929,765	·43840	·43758	·1744,356	·1714,643	·210,1771	3·155,8537
0·5	·4920,974	·54197	·54149	·1573,152	·1530,931	·342,3386	3·404,2283
0·6	·5918,251	·64194	·64190	·1359,499	·1306,395	·520,2635	3·745,3432
0·7	·6923,054	·73792	·73826	·1100,322	·1041,033	·758,5549	4·214,8982
0·8	·7937,001	·82966	·83025	·0791,481	·0734,847	1·081,1286	4·869,2635
0·9	·8961,933	·91703	·91736	·0427,345	·0387,836	1·533,4124	5·858,3872
1·0	1	1	1	0	0	∞	∞

It will be realised that while the ordinary value for the standard deviation of r and the distribution of r by a normal curve is fairly close for samples of 400, there is still a quite sensible deviation from normality in the case of $\rho = \cdot 8$ or over. In fact it may be said that for the size of ordinary samples, there is always a sensible

* Fisher, *Biometrika*, Vol. x. p. 516.

† See Sections (4) and (5) above.

‡ $\check{r} = \bar{r} + \mu_2 (\beta_2 + 3)/\{\mu_2 (10\beta_2 - 12\beta_1 - 18)\}$.

TABLE V. *Values of the Frequency Constants for the Correlation in Samples of* 50.

ρ	$\bar{r}$ mean	Actual $\check{r}$ mode	$\check{r}$ from Pearson's formula*	Actual σ	$\frac{1-\rho^2}{\sqrt{n-1}}$	β_1	β_2
0·0	0	0	0	·142,857	·142,857	0	2·88236
0·1	·098,995	·1054	·1053	·141,505	·141,429	·00666	2·89184
0·2	·198,047	·2104	·2102	·137,439	·137,143	·02683	2·93350
0·3	·297,218	·3147	·3144	·130,634	·130,000	·06107	2·99909
0·4	·396,565	·4180	·4177	·121,049	·120,000	·11041	3·09417
0·5	·496,150	·5198	·5196	·108,620	·107,143	·17635	3·22240
0·6	·596,038	·6201	·6199	·093,260	·091,429	·26110	3·38912
0·7	·696,295	·7184	·7183	·074,878	·072,857	·36774	3·60222
0·8	·796,989	·8146	·8146	·053,324	·051,429	·50037	3·87312
0·9	·898,198	·9085	·9085	·028,434	·027,143	·66608	4·22186
1·0	1	1	1	0	0	∞	∞

TABLE VI. *Values of the Frequency Constants for the Correlation in Samples of* 100.

ρ	$\bar{r}$ mean	Actual $\check{r}$ mode	$\check{r}$ from Pearson's formula*	Actual σ	$\frac{1-\rho^2}{\sqrt{n-1}}$	β_1	β_2
0·0	0	0	0	·100,5038	·100,5038	0	2·94060
0·1	·099,5016	·10258	·10255	·099,5260	·099,4987	·00346	2·94736
0·2	·199,0319	·20499	·20494	·096,5887	·096,4836	·01390	2·96774
0·3	·298,6219	·30708	·30701	·091,6832	·091,4584	·03147	3·00213
0·4	·398,3013	·40868	·40860	·084,7934	·084,4232	·05644	3·05118
0·5	·498,1002	·50964	·50957	·075,8968	·075,3778	·08919	3·11583
0·6	·598,0498	·60982	·60976	·064,9640	·064,3224	·13025	3·19739
0·7	·698,1815	·70907	·70903	·051,9577	·051,2569	·18031	3·29767
0·8	·798,5279	·80726	·80724	·036,8329	·036,1814	·24027	3·41896
0·9	·899,1225	·90427	·90423	·019,5352	·019,0957	·31148	3·57898
1·0	1	1	1	0	0	∞	∞

TABLE VII. *Values of the Frequency Constants for the Correlation in Samples of* 400.

ρ	$\bar{r}$ mean	Actual $\check{r}$ mode	$\check{r}$ from Pearson's formula*	Actual σ	$\frac{1-\rho^2}{\sqrt{n-1}}$	β_1	β_2
0·0	0	0	0	·0500,626	·0500,626	0	2·9850
0·1	·0998,760	·1006,250	·1006,232	·0495,654	·0495,620	·00089	2·9868
0·2	·1997,595	·2012,116	·2012,082	·0480,733	·0480,601	·00357	2·9921
0·3	·2996,579	·3017,217	·3017,171	·0455,851	·0455,570	·00804	3·0010
0·4	·3995,788	·4021,171	·4021,115	·0420,988	·0420,526	·01433	3·0138
0·5	·4995,297	·5023,602	·5023,584	·0376,115	·0375,470	·02250	3·0297
0·6	·5995,181	·6024,134	·6024,089	·0321,195	·0320,401	·03245	3·0498
0·7	·6995,517	·7022,401	·7022,386	·0256,183	·0255,319	·04435	3·0725
0·8	·7996,380	·8018,037	·8018,013	·0181,023	·0180,255	·05820	3·1017
0·9	·8997,849	·9010,725	·9010,668	·0095,653	·0095,119	·07402	3·1342
1·0	1	1	1	0	0	∞	∞

* $\check{r} = \bar{r} + \mu_3(\beta_2 + 3)/\{\mu_2(10\beta_2 - 12\beta_1 - 18)\}$.

deviation from normality for high values of ρ in the sampled population, and the usual "probable error of r" must be treated with caution in these cases. Pearson's curves would give better results, as is indicated by the agreement of $\check{r}$ to five figures.

(11) *Table for determining the Mode $\check{r}$ of the Frequency Distribution of considerable Size n when the Correlation in the sampled Population is known to be ρ.*

The required value of the mode is

$$\check{r} = \rho + \frac{\nu_1(\rho)}{n-1} + \frac{\nu_2(\rho)}{(n-1)^2} + \frac{\nu_3(\rho)}{(n-1)^3} + \frac{\nu_4(\rho)}{(n-1)^4},$$

when ρ is positive; if ρ be negative $\check{r}$ has the same value as for ρ positive, but with opposite sign.

TABLE VIII. *Functions required in determining the Mode of a large or fairly large Sample.*

ρ	$\nu_1(\rho)$	$\nu_2(\rho)$	$\nu_3(\rho)$	$\nu_4(\rho)$
·00	0	0	0	0
·05	·12468,75000	+ ·37872,26953	+1·13249,90199	+3·36913,85919
·10	·24750,00000	+ ·74237,62500	+2·18002,51688	+6·33154,83878
·15	·36656,25000	+1·07636,49609	+3·06395,34936	+8·53428,44284
·20	·48000,00000	+1·36704,00000	+3·71804,16000	+9·72192,80640
·25	·58593,75000	+1·60217,28516	+4·09383,77380	+9·77504,47690
·30	·68250,00000	+1·77142,87500	+4·16514,90563	+8·72821,01391
·35	·76781,25000	+1·86684,01172	+3·93125,67461	+6·77045,11170
·40	·84000,00000	+1·88328,00000	+3·41856,48000	+4·22414,17680
·45	·89718,75000	+1·81893,55078	+2·68036,91046	+1·50278,32653
·50	·93750,00000	+1·67578,12500	+1·79443,35938	− ·94981,38428
·55	·95906,25000	+1·46005,27734	+ ·85806,01815	−2·73364,05345
·60	·96000,00000	+1·18272,00000	− ·01966,08000	−3·57140,42880
·65	·93843,75000	+ ·85996,06641	− ·72873,29366	−3·38017,64160
·70	·89250,00000	+ ·51363,37500	−1·17258,21188	−2·31971,93665
·75	·82031,25000	+ ·17175,29297	−1·28614,42566	− ·79706,28440
·80	·72000,00000	− ·13104,00000	−1·05802,56000	+ ·59787,92160
·85	·58968,75000	− ·35300,16797	− ·55704,89418	+1·25603,36730
·90	·42750,00000	− ·44481,37500	+ ·03650,10188	+ ·84819,10191
·95	·23156,25000	− ·34910,94141	+ ·39461,98756	− ·19874,71356
1·00	0	0	0	0

The above Table will give the value of $\check{r}$ correctly to about the sixth figure if $n = 100$ or more, to about the fourth figure if $n = 25$ or more. Below 25 it can only serve as a "taking off point" for more accurate approximations, and these are fairly troublesome if n be very low. It will be found best to interpolate for the expression to be added to ρ.

Illustration. To find the modal $\check{r}$ for samples of 9 when $\rho = ·2852$.

$$\check{r} = \rho + ·106,272, \text{ for } \rho = ·25,$$

$$\check{r} = \rho + ·121,126, \text{ for } \rho = ·30.$$

Hence $\check{r} = \rho + \cdot 116{,}729$, for $\rho = \cdot 2852$

$= \cdot 4019$, say.

We cannot, however, be certain that this is correct to more than two figures.

Equation (xlvi) gives us $\check{r} = \cdot 4038$.

We will therefore start with $\check{r} = \cdot 4030$, say, as the basis of a more elaborate approximation, or $\rho_0^2 = \cdot 1149372$ say.

Hence calculating I_1 and I_2 and using the difference formula we find

$$\begin{aligned} I_1 &= 1\cdot 6972{,}3599, & I_6 &= 1\cdot 0465{,}6745, \\ I_2 &= 1\cdot 2110{,}7453, & I_7 &= 1\cdot 0879{,}1327, \\ I_3 &= 1\cdot 0715{,}7031, & I_8 &= 1\cdot 1443{,}9624, \\ I_4 &= 1\cdot 0262{,}1201, & I_9 &= 1\cdot 2145{,}9528, \\ I_5 &= 1\cdot 0236{,}1262, & I_{10} &= 1\cdot 2980{,}8251. \end{aligned}$$

Thus the equality of I_9 and I_{10} has not been reached, so that we could hardly anticipate (xlvi) giving a very good result. Using (xli) we find

$$\epsilon = + \cdot 0006{,}0228,$$

a sufficiently small correction, leading to $\rho_0^2 = \cdot 1155{,}3948$. and $\check{r} = \cdot 40512$, correct to the fourth figure. Table VIII for $n = 9$ gives $\check{r}$ in error by about 0·8 %.

(12) *Table for determining the "most probable" value $\hat{\rho}$ of the correlation in a sampled population from the knowledge of the correlation r in a sample of size n, when n is considerable and it is legitimate to distribute ignorance equally.*

The required value is

$$\hat{\rho} = r - \frac{\lambda_1(r)}{n-1} - \frac{\lambda_2(r)}{(n-1)^2} - \frac{\lambda_3(r)}{(n-1)^3},$$

when r is positive; if r be negative, $\hat{\rho}$ has the same value as for r positive, but with opposite sign.

The above formula using Table IX will give $\hat{\rho}$ correct to five figures if $n = 25$ or over, and correct to four figures if $n = 10$ or over.

It appears best to interpolate not for the separate λ-functions, but for the total value to be subtracted from r to find $\hat{\rho}$. Thus, suppose we require to find $\hat{\rho}$ for $r = \cdot 6781$ and for $n = 16$. We have for $r = \cdot 65$

$$\hat{\rho} = \cdot 65 - \cdot 0127{,}3515,$$

and for $r = \cdot 70$ $\hat{\rho} = \cdot 70 - \cdot 0121{,}8204.$

Therefore a difference of $- \cdot 0005{,}5311$ corresponds to a rise of ·05 and accordingly one of $- \cdot 0003{,}1085$ to a rise of ·0281. Thus

$$\hat{\rho} = \cdot 6781 - \cdot 0124{,}2430$$

$= \cdot 6657$, accurately.

TABLE IX. *Functions required in determining the "most probable" value $\hat{\rho}$ of the Correlation.*

r	$\lambda_1(r)$	$\lambda_2(r)$	$\lambda_3(r)$
·00	0	0	0
·05	·02493,75000	−·00615,64453	−·00317,92000
·10	·04950,00000	−·01175,62500	−·00667,19813
·15	·07331,25000	−·01626,62109	−·01073,47255
·20	·09600,00000	−·01920,00000	−·01551,36000
·25	·11718,75000	−·02014,16016	−·02099,99084
·30	·13650,00000	−·01876,87500	−·02699,79938
·35	·15356,25000	−·01487,63672	−·03310,98746
·40	·16800,00000	−·00840,00000	−·03874,08000
·45	·17943,75000	+·00056,07422	−·04312,99059
·50	·18750,00000	+·01171,87500	−·04541,01563
·55	·19181,25000	+·02457,59766	−·04470,17533
·60	·19200,00000	+·03840,00000	−·04024,32000
·65	·18768,75000	+·05220,05859	−·03156,41987
·70	·17850,00000	+·06470,62500	−·01870,45688
·75	·16406,25000	+·07434,08203	−·00248,33679
·80	·14400,00000	+·07920,00000	+·01517,76000
·85	·11793,75000	+·07702,79297	+·03087,17070
·90	·08550,00000	+·06519,37500	+·03926,26688
·95	·04631,25000	+·04066,81641	+·03257,27752
1·00	0	0	0

(13) *On the Table for* $q_n = \int_0^{\frac{\pi}{2}} \sin^{n-1}\phi\, d\phi$.

While Table X, p. 377, gives the value of $q_n = \int_0^{\frac{\pi}{2}} \sin^{n-1}\phi\, d\phi$ to ten figures, and therefore will be of use in calculating the values of the moments, the reader may be compelled to deal with values of n greater than those tabled, or even may need more than ten significant figures. The present values were calculated to twelve figures, by means of the simple relations

$$q_{2p+2} = q_{2p} - \frac{1}{2p+1} q_{2p},$$

$$q_{2p+1} = q_{2p-1} - \frac{1}{2p} q_{2p-1},$$

with the control relation $q_{2p} \times q_{2p-1} = \frac{\pi}{2} \frac{1}{2p-1}$, and the occasional direct calculation of individual q_n's to control the accuracy by use of Degen's Tables* and Briggs's *Arithmetica Logarithmica*†.

Since
$$q_{2p+1} = \frac{(2p)!}{2^{2p}\{(p)!\}^2} \frac{\pi}{2} \quad \text{.....(xcii),}$$

and
$$q_{2p} = \frac{2^{2p}\{(p)!\}^2}{2p\,(2p)!} \quad \text{.....(xciii),}$$

* Tabularum ad faciliorem et breviorem probabilitatis computationem utilium Enneas. C. F. Degen, Havniae, 1824.

† Londini, W. Jones, 1624.

and Degen gives the logarithms of the factorials up to 1200! to eighteen mantissa figures, there is no difficulty in getting the logarithms of the q_n's to 18 figures. All we need is the value of either $\log \frac{\pi}{2}$ or $\frac{\pi}{2}$ to an adequate number of places*. But for modern methods of machine calculation the logarithm is of small service and we need in this case to find also the antilogarithm. Let us illustrate the process in the determination of q_{104}:

$$\left.\begin{aligned} \log q_{104} &= 104 \log 2 \\ &+ 2 \log (52!) \\ &- \log 104 \\ &- \log (104!) \end{aligned}\right\} \begin{aligned} &= \ 31{\cdot}307119{,}549054{,}044280 \\ &+ 135{\cdot}813296{,}784409{,}541764 \\ &- \ \ 2{\cdot}017033{,}339298{,}780355 \\ &- 166{\cdot}012795{,}764264{,}301069 \end{aligned}$$

$$= \bar{1}{\cdot}090587{,}229{,}900{,}504{,}620.$$

Thus far the work is very straightforward. But to obtain the antilogarithm to twelve figures is another matter. Tables like the original Vega (to 10 figures) or Mendizabel (to 8 figures) are not of service. We are thus compelled to use Briggs's 14 figure Table of Logarithms, but the fundamental defect of that magnificent piece of work is the largeness of the differences. The nearest logarithm to the above is log (·12319) = 1·090575,455222,21 with the remainder

$$r = \cdot 000011{,}774678{,}29,$$

and the difference ·000035,252606,20. Mere linear interpolation gives

$$\cdot 1231{,}9334{,}0087{,}32,$$

which is wrong in the tenth figure.

We have therefore used the method of inverse interpolation given in the *Tables for Statisticians*† as (vii)^{bis} on p. xiv. Unfortunately there are two misprints in the value given there (corrected in the *Errata*); it should run

$$\theta^2 \tfrac{1}{4} (-u_0 - u_1 + u_{-1} + u_2) + \theta \tfrac{1}{4} (5u_1 - 3u_0 - u_{-1} - u_2) + u_0 - u_0(\theta) = 0 \quad \ldots\ldots\ldots(\text{xciv}).$$

But from Briggs's tables,

$$\begin{aligned} u_{-1} &= \cdot 0905{,}4019{,}9754{,}24, \\ u_0 &= \cdot 0905{,}7545{,}5222{,}21, \\ u_{+1} &= \cdot 0906{,}1070{,}7828{,}41, \\ u_{+2} &= \cdot 0906{,}4595{,}7573{,}32, \end{aligned}$$

whence

$$\cdot 0001{,}4101{,}614786\,\theta = \cdot 0000{,}4709{,}8713{,}16 + \theta^2 \times \cdot 0000{,}00005723{,}06,$$

or,

$$\theta = \frac{\cdot 4709{,}8713{,}16}{1{\cdot}4101{,}6147{,}86} + \theta^2 \frac{\cdot 0000{,}5723{,}06}{1{\cdot}4101{,}6147{,}86}.$$

* $\frac{\pi}{2} = 1{\cdot}570796{,}326794{,}8966$; $\log \frac{\pi}{2} = \cdot 196119{,}877030{,}1527$.

† Cambridge University Press, 1914.

To a first approximation

$$\theta_1 = \frac{\cdot 4709,8713,16}{1\cdot 4101,6147}\left(1 - \frac{\cdot 0000,0000,86}{1\cdot 4101,6147}\right),$$

arranging it thus as most machines cannot divide by more than *nine* figures. Hence

$$\theta_1 = \cdot 3339,9517,625.$$

Substitute in the θ^2 term and we find

$$\theta_2 = \cdot 3339,9970,356,$$

or the value of $q_{104} = \cdot 1231,9333,9997$ to twelve figures. Found by the continuous process it was $\cdot 1231,9333,9996$, so that the value tabled is correct to the tenth figure.

TABLE X. *Values of the Integral* $q_n = \int_0^{\frac{\pi}{2}} \sin^{n-1}\phi\, d\phi = \int_0^{\frac{\pi}{2}} \cos^{n-1}\phi\, d\phi.$

n	q_n	n	I_n	n	I_n
1	1·5707,9632,68	36	·2103,4114,55	71	·1492,6566,48
2	1·0000,0000,00	37	·2074,4030,47	72	·1482,1822,53
3	·7853,9816,34	38	·2046,5624,97	73	·1471,9253,06
4	·6666,6666,67	39	·2019,8134,93	74	·1461,8783,86
5	·5890,4862,25	40	·1994,0865,35	75	·1452,0344,23
6	·5333,3333,33	41	·1969,3181,56	76	·1442,3866,74
7	·4908,7385,21	42	·1945,4502,78	77	·1432,9287,07
8	·4571,4285,71	43	·1922,4296,29	78	·1423,6543,80
9	·4295,1462,06	44	·1900,2072,49	79	·1414,5578,26
10	·4063,4920,63	45	·1878,7380,46	80	·1405,6334,38
11	·3865,6315,85	46	·1857,9804,21	81	·1396,8758,53
12	·3694,0836,94	47	·1837,8959,15	82	·1388,2799,39
13	·3543,4956,20	48	·1818,4489,23	83	·1379,8407,82
14	·3409,9234,10	49	·1799,6064,16	84	·1371,5536,75
15	·3290,3887,90	50	·1781,3377,19	85	·1363,4141,06
16	·3182,5951,83	51	·1763,6142,88	86	·1355,4177,49
17	·3084,7394,91	52	·1746,4095,29	87	·1347,5604,54
18	·2995,3837,01	53	·1729,6986,29	88	·1339,8382,35
19	·2913,3650,74	54	·1713,4584,06	89	·1332,2472,67
20	·2837,7319,28	55	·1697,6671,73	90	·1324,7838,73
21	·2767,6968,21	56	·1682,3046,16	91	·1317,4445,19
22	·2702,6018,36	57	·1667,3516,87	92	·1310,2258,08
23	·2641,8924,20	58	·1652,7905,00	93	·1303,1244,70
24	·2585,0974,08	59	·1638,6042,44	94	·1296,1373,58
25	·2531,8135,69	60	·1624,7771,02	95	·1289,2614,44
26	·2481,6935,12	61	·1611,2941,74	96	·1282,4938,07
27	·2434,4361,24	62	·1598,1414,12	97	·1275,8316,37
28	·2389,7789,37	63	·1585,3055,58	98	·1269,2722,22
29	·2347,4919,77	64	·1572,7740,88	99	·1262,8129,47
30	·2307,3727,67	65	·1560,5351,59	100	·1256,4512,90
31	·2269,2422,44	66	·1548,5775,63	101	·1250,1848,17
32	·2232,9413,87	67	·1536,8906,87	102	·1244,0111,78
33	·2198,3284,24	68	·1525,4644,65	103	·1237,9281,04
34	·2165,2764,98	69	·1514,2893,53	104	·1231,9334,00
35	·2133,6717,06	70	·1503,3562,85	105	·1226,0249,49

Something corresponding to the above process must be used for values of q_n with $n > 105$, if we require the function correct to ten or twelve figures. The usual approximate formulae for the factorial, or for the Γ-function, do not converge rapidly enough and generally give the logarithm, so that they really involve the use of the logarithm tables to 14 places and the antilogarithm process.

For values of 100 and upwards the following formula will be found good:

For n even we deduce by Stirling's Theorem from Eqn. (xcii)

$$q_n = \frac{1{\cdot}2533,1413,7315}{\sqrt{n}}\left(1 + \frac{{\cdot}25}{n} + \frac{{\cdot}03125}{n^2} - \frac{{\cdot}039,0625}{n^3} - \frac{{\cdot}0102,5390,625}{n^4}\right) \quad \text{(xcv)}.$$

For example, $n = 100$

$$\begin{aligned} q_{100} &= 1{\cdot}2533,1413,7315 \times {\cdot}1002,5031,64165, \\ &= {\cdot}1256,4512,9017,89, \end{aligned}$$

which is correct to twelve places.

For n odd we deduce by Stirling's Theorem from Eqn. (xcii) by somewhat more lengthy algebra precisely the same value.

[Owing to the growth of this memoir far beyond its original limits, it has been found impossible to include in this first portion the experimental work which accompanied the algebraical investigations, nor to give illustrations of the various uses which the tables serve. These matters are therefore reserved for a continuation of this memoir, which will appear later.]

APPENDIX.

CORRELATION IN SMALL SAMPLES.

TABLE A. *Ordinates and Constants of Frequency Curves*.*

$n = 3$ ρ variate (correlation in population sampled).

r variate (correlation in sample).	·0	·1	·2	·3	·4	·5	·6	·7	·8	·9
− 1·00	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
− ·95	1019·41	874·99	744·21	624·87	515·25	413·97	319·92	232·19	150·04	72·82
− ·90	730·25	631·33	540 26	456·01	377·73	304·70	236·31	172·05	111·49	54·25
− ·85	604·25	526·19	453·08	384·48	319·97	259·17	201·74	147·37	95·78	46·73
− ·80	530·52	465·35	403·21	344·03	287·69	234·02	182·85	134·03	87·38	42·75
− ·75	481·24	425·22	370·79	318·13	267·34	218·43	171·35	126·04	82·44	40·45
− ·70	445·72	396·74	348·18	300·44	253·76	208·27	164·05	121·12	79·49	39·12
− ·65	418·87	375·59	331·78	287·95	244·48	201·60	159·47	118·20	77·84	38·44
− ·60	397·89	359·43	319·60	279·03	238·18	197·36	156·81	116·70	77·14	38·22
− ·55	381·13	346·87	310·50	272·73	234·08	194·94	155·60	116·29	77·18	38·38
− ·50	367·55	337·02	303·74	268·44	231·71	193·97	155·57	116·79	77·82	38·85
− ·45	356·44	329·29	298·82	265·77	230·74	194·20	156·54	118·06	79·02	39·61
− ·40	347·30	323·28	295·41	264·44	230·97	195·48	158·40	120·05	80·72	40·63
− ·35	339·80	318·70	293·29	264·28	232·26	197·72	161·09	122·71	82·91	41·93
− ·30	333·68	315·35	292·30	265·17	234·53	200·85	164·58	126·05	85·60	43·51
·25	328·75	313·08	292·30	267·01	237·71	204·86	168·86	130·08	88·82	45·38
− ·20	324·87	311·77	293·24	269·76	241·79	209·74	173·97	134·82	92·59	47·57
− ·15	321·95	311·36	295·05	273·39	246·77	215·51	179·94	140·33	96·98	50·12
− ·10	319·91	311·80	297·71	277·91	252·66	222·22	186·82	146·69	102·04	53·08
− ·05	318·71	313·06	301·21	283·32	259·51	229·93	194·72	153·99	107·88	56·51
·00	318·31	315·13	305·58	289·66	267·38	238·73	203·72	162·34	114·59	60·48
+ ·05	318·71	318·02	310·83	296·99	276·35	248·73	213·97	171·89	122·33	65·09
+ ·10	319·91	321·75	317·02	305·38	286·51	260·05	225·63	182·84	131·27	70·48
+ ·15	321·95	326·39	324·22	314·94	298·02	272·89	238·91	195·41	141·63	76·79
+ ·20	324·87	331·99	332·52	325·79	311·04	287·45	254·08	209·89	153·71	84·24
+ ·25	328·75	338·66	342·06	338·10	325·78	304·00	271·45	226·66	167·88	93·11
+ ·30	333·68	346·53	353·00	352·08	342·52	322·88	291·45	246·18	184·60	103·75
+ ·35	339·80	355·76	365·56	368·00	361·58	344·53	314·60	269·08	204·53	116·66
+ ·40	347·30	366·59	380·02	386·21	383·43	369·48	341·59	296·15	228·52	132·54
+ ·45	356·44	379·35	396·75	407·18	408·63	398·48	373·30	328·48	257·73	152·34
+ ·50	367·55	394·39	416·27	431·53	437·95	432·48	410·96	367·53	293·80	177·48
+ ·55	381·13	412·36	439·27	460·12	472·45	472·82	456·23	415·36	339·09	210·05
+ ·60	397·89	434·08	466·77	494·15	513·63	521·35	511·47	474·92	397·07	253·32
+ ·65	418·87	460·81	500·25	535·44	563·68	580·81	580·15	550·63	473·12	312·61
+ ·70	445·72	494·50	542·05	586·77	626·01	655·44	667·63	649·38	575·90	396·99
+ ·75	481·24	538·43	596·05	652·77	706·23	752·17	782·72	782·63	720·25	523·20
+ ·80	530·52	598·63	669·27	741·91	814·50	883·48	941·21	971·06	933·85	724·94
+ ·85	604·25	687·68	776·82	871·73	971·83	1074·99	1175·29	1256·88	1274·71	1079·64
+ ·90	730·25	838·25	956·77	1087·46	1232·06	1391·88	1566·09	1745·85	1890·70	1804·95
+ ·95	1019·41	1180·31	1361·48	1568·00	1806·93	2088·24	2426·12	2839·55	3341·78	3802·31
+ 1·00	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
Mean	·0000	·0786	·1579	·2384	·3209	·4063	·4960	·5919	·6976	·8204
Antimode	− ·0000	− ·1513	− ·2755	− ·3679	− ·4354	− ·4855	− ·5239	− ·5539	− ·5779	− ·5976
σ	·7071	·7045	·6966	·6829	·6629	·6351	·5977	·5470	·4755	·3635
$(1-\rho^2)/\sqrt{n-1}$	·7071	·7000	·6788	·6435	·5940	·5303	·4525	·3606	·2546	·1344
β_1	·0000	·0280	·1152	·2722	·5206	·9018	1·5002	2·5105	4·5031	10·2226
β_2	1·5000	1·5323	1·6329	1·8142	2·1011	2·5423	3·2363	4·4114	6·7388	13·4672

* In all cases the total frequency of the curve is taken as 1000.

TABLE A. *Ordinates and Constants of Frequency Curves.*

$n = 4$. ρ variate (correlation in population sampled).

r variate (correlation in sample).

	0	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*	*·7*	*·8*	*·9*
− *1·00*	500·00	386·33	295·47	222·28	163·11	115·34	77·06	46·93	24·03	8·02
− *·95*	500·00	390·84	301·85	228·97	169·22	120·41	80·89	49·50	25·46	8·53
− *·90*	500·00	395·43	308·42	235·94	175·66	125·79	84·99	52·27	27·01	9·09
− *·85*	500·00	400·09	315·19	243·21	182·44	131·52	89·38	55·26	28·69	9·69
− *·80*	500·00	404·83	322·17	250·79	189·59	137·61	94·10	58·49	30·52	10·36
− *·75*	500·00	409·64	329·36	258·71	197·13	144·10	99·16	61·99	32·51	11·08
− *·70*	500·00	414·54	336·78	266·97	205·09	151·02	104·61	65·79	34·69	11·89
− *·65*	500·00	419·52	344·44	275·61	213·51	158·41	110·48	69·92	37·08	12·77
− *·60*	500·00	424·58	352·34	284·64	222·42	166·31	116·82	74·41	39·70	13·75
− *·55*	500·00	429·73	360·49	294·09	231·85	174·77	123·68	79·32	42·58	14·83
− *·50*	500·00	434·96	368·90	303·97	241·84	183·84	131·10	84·68	45·76	16·04
− *·45*	500·00	440·28	377·59	314·32	252·44	193·57	139·16	90·56	49·28	17·39
− *·40*	500·00	445·69	386·57	325·17	263·69	204·03	147·92	97·03	53·19	18·90
− *·35*	500·00	451·20	395·84	336·54	275·65	215·29	157·46	104·15	57·54	20·59
− *·30*	500·00	456·80	405·43	348·48	288·38	227·44	167·88	112·01	62·40	22·51
− *·25*	500·00	462·50	415·34	361·01	301·94	240·55	179·28	120·72	67·85	24·68
− *·20*	500·00	468·30	425·59	374·17	316·40	254·74	191·79	130·41	73·98	27·16
− *·15*	500·00	474·19	436·20	388·01	331·84	270·11	205·53	141·20	80·91	29·99
− *·10*	500·00	480·20	447·17	402·57	348·34	286·81	220·69	153·27	88·77	33·25
− *·05*	500·00	486·30	458·53	417·89	366·00	304·96	237·43	166·83	97·73	37·02
·00	500·00	492·52	470·30	434·04	384·94	324·76	256·00	182·11	108·00	41·41
+ *·05*	500·00	498·85	482·49	451·07	405·26	346·38	276·64	199·40	119·83	46·56
+ *·10*	500·00	505·29	495·13	469·04	427·09	370·06	299·67	219·05	133·53	52·64
+ *·15*	500·00	511·84	508·23	488·02	450·60	396·04	325·45	241·50	149·52	59·89
+ *·20*	500·00	518·52	521·81	508·08	475·94	424·63	354·41	267·28	168·29	68·60
+ *·25*	500·00	525·31	535·90	529·31	503·31	456·16	387·08	297·05	190·49	79·17
+ *·30*	500·00	532·23	550·53	551·79	532·91	491·05	424·09	331·63	216·99	92·15
+ *·35*	500·00	539·28	565·72	575·62	564·99	529·75	466·20	372·07	248·90	108·29
+ *·40*	500·00	546·46	581·49	600·89	599·81	572·82	514·35	419·70	287·74	128·65
+ *·45*	500·00	553·77	597·89	627·74	637·68	620·92	569·71	476·24	335·53	154·74
+ *·50*	500·00	561·22	614·93	656·28	678·96	674·81	633·70	543·96	395·13	188·83
+ *·55*	500·00	568·81	632·65	686·66	724·05	735·44	708·15	625·86	470·54	234·34
+ *·60*	500·00	576·54	651·09	719·03	773·41	803·91	795·33	725·97	567·57	296·69
+ *·65*	500·00	584·41	670·29	753·55	827·57	881·57	898·20	849·83	694·88	384·78
+ *·70*	500·00	592·44	690·28	790·43	887·15	970·08	1020·55	1005·20	865·74	514·05
+ *·75*	500·00	600·62	711·11	829·86	952·87	1071·44	1167·38	1203·12	1101·28	712·86
+ *·80*	500·00	608·96	732·82	872·07	1025·55	1188·16	1345·36	1459·79	1436·61	1037·65
+ *·85*	500·00	617·46	755·47	917·33	1106·18	1323·35	1563·48	1799·62	1933·28	1612·67
+ *·90*	500·00	626·13	779·10	965·92	1195·91	1480·93	1834·16	2260·62	2706·28	2751·97
+ *·95*	500·00	634·97	803·76	1018·17	1296·08	1665·90	2174·80	2904·38	3989·04	5425·82
+ *1·00*	500·00	643·98	829·53	1074·43	1408·32	1884·66	2610·44	3835·42	6309·30	13781·45
Mean	·0000	·0850	·1705	·2570	·3453	·4360	·5302	·6293	·7357	·8540
Mode	Non-existent									
σ	·5774	·5746	·5661	·5516	·5304	·5013	·4626	·4111	·3407	·2367
$(1-\rho^2)/\sqrt{n-1}$	·5774	·5716	·5543	·5254	·4850	·4330	·3695	·2944	·2078	·1097
β_1	·0000	·0314	·1295	·3069	·5895	1·0283	1·7284	2·9402	5·4289	13·1840
β_2	1·8000	1·8399	1·9647	2·1907	2·5522	3·1163	4·0230	5·6093	8·9222	19·5710

TABLE A—(*continued*).

$n = 5$. ρ variate (correlation in population sampled).

r variate (correlation in sample).	*0*	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*	*·7*	*·8*	*·9*
− 1·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
− ·95	198·78	141·35	99·03	67·80	44·87	28·25	16·49	8·50	3·48	·80
− ·90	277·50	200·54	142·43	98·66	65·96	41·90	24·65	12·79	5·27	1·22
− ·85	335·36	246·33	177·39	124·35	84·01	53·86	31·94	16·70	6·92	1·62
− ·80	381·97	285·19	208·27	147·80	100·93	65·32	39·06	20·58	8·59	2·02
− ·75	421·08	319·60	236·74	170·10	117·44	76·75	46·30	24·59	10·33	2·45
− ·70	454·64	350·80	263·63	191·85	133·96	88·43	53·84	28·82	12·20	2·91
− ·65	483·79	379·53	289·41	213·36	150·72	100·55	61·79	33·37	14·24	3·42
− ·60	509·30	406·24	314·40	234·88	167·91	113·24	70·28	38·30	16·48	3·99
− ·55	531·68	431·25	338·80	256·56	185·68	126·63	79·40	43·68	18·96	4·62
− ·50	551·33	454·76	362·75	278·52	204·14	140·84	89·26	49·59	21·72	5·34
− ·45	568·52	476·92	386·34	300·86	223·41	156·00	99·98	56·12	24·82	6·16
− ·40	583·47	497·83	409·64	323·65	243·58	172·23	111·67	63·37	28·32	7·10
− ·35	596·35	517·56	432·68	346·96	264·76	189·65	124·47	71·45	32·27	8·17
− ·30	607·30	536·16	455·50	370·82	287·04	208·40	138·53	80·49	36·78	9·41
− ·25	616·40	553·64	478·09	395·29	310·51	228·62	154·02	90·65	41·92	10·86
− ·20	623·76	570·02	500·44	420·38	335·28	250·49	171·14	102·08	47·83	12·54
− ·15	629·42	585·27	522·52	446·12	361·44	274·17	190·10	115·02	54·64	14·52
− ·10	633·43	599·37	544·31	472·50	389·09	299·86	211·15	129·71	62·54	16·86
− ·05	635·82	612·28	565·73	499·53	418·31	327·76	234·60	146·44	71·74	19·65
·00	636·62	623·95	586·71	527·18	449·20	358·10	260·76	165·58	82·51	22·98
+ *·05*	635·82	634·31	607·16	555·41	481·84	391·13	290·03	187·57	95·19	27·01
+ *·10*	633·43	643·27	626·97	584·15	516·30	427·11	322·86	212·91	110·22	31·91
+ *·15*	629·42	650·74	645·99	613·31	552·65	466·33	359·76	242·26	128·14	37·93
+ *·20*	623·76	656·59	664·06	642·76	590·91	509·09	401·33	276·40	149·65	45·39
+ *·25*	616·40	660·68	680·97	672·33	631·08	555·72	448·27	316·29	175·68	54·74
+ *·30*	607·30	662·86	696·46	701·77	673·11	606·51	501·37	363·13	207·42	66·60
+ *·35*	596·35	662·91	710·24	730·79	716·87	661·77	561·55	418·41	246·48	81·84
+ *·40*	583·47	660·60	721·95	758·98	762·14	721·75	629·83	483·98	295·00	101·75
+ *·45*	568·52	655·66	731·14	785·81	808·54	786·62	707·37	562·17	355·92	128·18
+ *·50*	551·33	647·74	737·25	810·60	855·49	856·39	795·39	655·88	433·30	163·98
+ *·55*	531·68	636·41	739·59	832·42	902·10	930·77	895·14	768·74	532·81	213·57
+ *·60*	509·30	621·15	737·29	850·06	947·05	1009·03	1007·71	905·20	662·54	284·13
+ *·65*	483·79	601·26	729·21	861·85	988·36	1089·62	1133·68	1070·61	834·18	387·69
+ *·70*	454·64	575·83	713·82	865·50	1023·03	1169·66	1272·51	1270·96	1064·70	545·45
+ *·75*	421·08	543·59	689·01	857·73	1046·50	1243·92	1421·02	1511·86	1378·85	796·89
+ *·80*	381·97	502·63	651·67	833·60	1051·45	1302·93	1570·47	1795·27	1811·55	1220·21
+ *·85*	335·36	449·87	596·86	785·20	1025·58	1328·96	1699·62	2109·71	2406·01	1981·91
+ *·90*	277·50	379·52	515·46	698·04	945·84	1286·02	1756·53	2398·74	3182·44	3457·80
+ *·95*	198·78	277·21	385·59	538·03	757·76	1085·21	1595·22	2436·67	3917·02	6392·40
+ *1·00*	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
Mean	·0000	·0884	·1773	·2671	·3584	·4517	·5480	·6482	·7541	·8687
Mode	·0000	·3264	·5520	·6936	·7863	·8500	·8965	·9318	·9595	·9817
σ	·5000	·4972	·4886	·4740	·4528	·4239	·3858	·3358	·2691	·1748
$(1-\rho^2)/\sqrt{n-1}$	·5000	·4950	·4800	·4550	·4200	·3750	·3200	·2550	·1800	·0950
β_1	·0000	·0315	·1299	·3077	·5909	1·0315	1·7297	2·9374	5·4065	13·0290
β_2	2·0000	2·0429	2·1769	2·4201	2·8097	3·4191	4·4027	6·1333	9·7830	21·7579

TABLE A. *Ordinates and Constants of Frequency Curves.*

$n = 6$. ρ variate (correlation in population sampled).

r variate (correlation in sample).	*0*	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*	*·7*	*·8*	*·9*
− 1·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
− ·95	73·125	47·28	30·03	18·55	10·99	6·12	3·10	1·35	·44	·07
− ·90	142·500	94·07	60·81	38·13	22·88	12·89	6·60	2·89	·95	·15
− ·85	208·125	140·28	92·30	58·76	35·74	20·37	10·54	4·66	1·54	·25
− ·80	270·000	185·83	124·49	80·50	49·64	28·64	14·97	6·68	2·23	·36
− ·75	328·125	230·63	157·34	103·38	64·65	37·76	19·96	9·00	3·03	·50
− ·70	382·500	274·58	190·82	127·43	80·85	47·84	25·59	11·66	3·96	·66
− ·65	433·125	317·59	224·87	152·69	98·33	58·96	31·92	14·71	5·05	·85
− ·60	480·000	359·54	259·44	179·18	117·16	71·24	39·06	18·20	6·32	1·07
− ·55	523·125	400·33	294·48	206·94	137·45	84·78	47·09	22·22	7·79	1·33
− ·50	562·500	439·82	329·89	235·97	159·29	99·73	56·16	26·83	9·52	1·64
− ·45	598·125	477·89	365·60	266·29	182·79	116·21	66·38	32·13	11·55	2·02
− ·40	630·000	514·41	401·49	297·90	208·03	134·39	77·92	38·25	13·93	2·46
− ·35	658·125	549·23	437·46	330·80	235·13	154·44	90·95	45·31	16·73	3·00
− ·30	682·500	582·20	473·37	364·95	264·20	176·55	105·68	53·47	20·03	3·64
− ·25	703·125	613·16	509·07	400·33	295·32	200·93	122·35	62·92	23·94	4·41
− ·20	720·000	641·93	544·37	436·88	328·62	227·80	141·22	73·89	28·59	5·35
− ·15	733·125	668·33	579·08	474·49	364·17	257·41	162·61	86·65	34·12	6·50
− ·10	742·500	692·18	612·97	513·07	402·05	290·01	186·88	101·53	40·75	7·91
− ·05	748·125	713·27	645·79	552·46	442·32	325·89	214·44	118·92	48·71	9·65
·00	750·000	731·39	677·23	592·47	485·02	365·35	245·76	139·31	58·32	11·80
+ ·05	748·125	746·31	706·99	632·84	530·14	408·70	281·39	163·28	69·98	14·50
+ ·10	742·500	757·78	734·67	673·26	577·63	456·23	321·94	191·55	84·21	17·90
+ ·15	733·125	765·56	759·87	713·34	627·35	508·26	368·14	224·98	101·67	22·24
+ ·20	720·000	769·38	782·10	752·61	679·10	565·04	420·76	264·66	123·24	27·81
+ ·25	703·125	768·94	800·84	790·47	732·53	626·81	480·72	311·90	150·07	35·06
+ ·30	682·500	763·96	815·48	826·21	787·15	693·69	548·97	368·33	183·69	44·60
+ ·35	658·125	754·11	825·36	858·93	842·24	765·62	626·56	435·94	226·18	57·33
+ ·40	630·000	739·06	829·70	887·57	896·80	842·35	714·54	517·20	280·35	74·61
+ ·45	598·125	718·45	827·66	910·82	949·48	923·20	813·87	615·10	350·06	98·48
+ ·50	562·500	691·90	818·27	927·11	998·43	1006·98	925·29	733·19	440·67	132·11
+ ·55	523·125	659·02	800·46	934·53	1041·18	1091·61	1048·92	875·62	559·69	180·65
+ ·60	480·000	619·39	772·99	930·76	1074·42	1173·81	1183·82	1046·92	717·69	252·62
+ ·65	433·125	572·56	734·52	913·01	1093·74	1248·41	1326·99	1251·36	929·54	362·77
+ ·70	382·500	518·05	683·50	877·89	1093·27	1307·53	1471·73	1491·35	1215·82	537·74
+ ·75	328·125	455·38	618·19	821·29	1065·22	1339·14	1604·80	1763·58	1603·56	828·01
+ ·80	270·000	384·02	536·66	738·25	999·24	1325·11	1701·20	2050·08	2122·58	1334·30
+ ·85	208·125	303·41	436·70	622·74	881·50	1237·97	1714·92	2297·17	2783·31	2265·98
+ ·90	142·500	212·95	315·86	467·45	693·60	1036·09	1561·73	2364·83	3479·97	4043·96
+ ·95	73·125	112·04	171·33	263·48	410·83	655·98	1086·58	1899·93	3578·10	7013·72
+ 1·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
Mean	·0000	·0906	·1816	·2734	·3665	·4614	·5587	·6594	·7646	·8766
Mode	·0000	·2197	·4101	·5599	·6747	·7630	·8321	·8870	·9319	·9689
σ	·4472	·4444	·4360	·4216	·4007	·3725	·3356	·2878	·2253	·1397
$(1-\rho^2)/\sqrt{n-1}$	·4472	·4427	·4293	·4070	·3757	·3354	·2862	·2281	·1610	·0850
β_1	·0000	·0304	·1251	·2959	·5667	·9838	1·6418	2·7599	4·9848	11·4554
β_2	2·1429	2·1863	2·3222	2·5682	2·9615	3·5746	4·5585	6·2752	9·8417	21·1653

TABLE A—(*continued*).

$n = 7$. ρ variate (correlation in population sampled).

r variate (correlation in sample).	*0*	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*	*·7*	*·8*	*·9*
– 1·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
– ·95	25·84	15·19	8·75	4·87	2·58	1·27	·56	·20	·05	·01
– ·90	70·30	42·38	24·93	14·14	7·62	3·81	1·69	·63	·16	·02
– ·85	124·08	76·72	46·12	26·66	14·60	7·39	3·34	1·25	·33	·04
– ·80	183·35	116·30	71·46	42·10	23·44	12·05	5·51	2·08	·56	·06
– ·75	245·63	159·85	100·42	60·33	34·17	17·84	8·26	3·16	·85	·10
– ·70	309·15	206·44	132·64	81·28	46·85	24·84	11·67	4·53	1·24	·14
– ·65	372·52	255·27	167·80	104·93	61·59	33·20	15·83	6·22	1·72	·20
– ·60	434·60	305·66	205·61	131·26	78·49	43·03	20·83	8·30	2·32	·27
– ·55	494·46	356·96	245·82	160·28	97·70	54·50	26·81	10·85	3·08	·37
– ·50	551·33	408·59	288·14	191·98	119·36	67·80	33·92	13·93	4·01	·49
– ·45	604·53	459·99	332·29	226·34	143·61	83·12	42·31	17·66	5·16	·63
– ·40	653·49	510·59	377·96	263·34	170·62	100·70	52·20	22·16	6·58	·82
– ·35	697·73	559·87	424·83	302·91	200·54	120·78	63·81	27·58	8·32	1·05
– ·30	736·85	607·28	472·53	344·98	233·54	143·64	77·42	34·10	10·48	1·35
– ·25	770·51	652·32	520·67	389·43	269·77	169·60	93·33	41·94	13·13	1·72
– ·20	798·41	694·44	568·81	436·10	309·36	198·97	111·92	51·36	16·41	2·19
– ·15	820·34	733·15	616·47	484·78	352·43	232·12	133·60	62·69	20·47	2·80
– ·10	836·13	767·91	663·12	535·18	399·06	269·42	158·87	76·33	25·50	3·56
– ·05	845·65	798·24	708·17	586·95	449·29	311·28	188·29	92·77	31·77	4·55
·00	848·83	823·62	750·99	639·65	503·10	358·10	222·51	112·60	39·60	5·82
+ *·05*	845·65	843·56	790·87	692·72	560·37	410·29	262·29	136·56	49·43	7·48
+ *·10*	836·13	857·59	827·06	745·49	620·88	468·23	308·46	165·58	61·82	9·65
+ *·15*	820·34	865·26	858·73	797·15	684·25	532·27	361·98	200·77	77·52	12·53
+ *·20*	798·41	866·13	884·99	846·70	749·91	602·63	423·92	243·54	97·54	16·38
+ *·25*	770·51	859·80	904·89	893·00	817·07	679·42	495·43	295·61	123·21	21·58
+ *·30*	736·85	845·93	917·44	934·67	884·59	762·49	577·72	359·10	156·38	28·71
+ *·35*	697·73	824·21	921·57	970·10	950·96	851·33	671·98	436·64	199·53	38·62
+ *·40*	653·49	794·40	916·22	997·43	1014·18	944·93	779·26	531·38	256·18	52·62
+ *·45*	604·52	756·38	900·29	1014·55	1071·64	1041·52	900·25	647·10	331·09	72·76
+ *·50*	551·33	710·11	872·71	1019·07	1120·03	1138·25	1034·91	788·14	431·03	102·38
+ *·55*	494·46	655·69	832·49	1008·34	1155·12	1230·82	1181·85	959·18	565·53	147·00
+ *·60*	434·60	593·44	778·80	979·51	1171·74	1312·87	1337·35	1164·60	747·90	216·12
+ *·65*	372·52	523·87	711·02	929·65	1163·57	1375·33	1493·80	1406·95	996·60	326·69
+ *·70*	309·15	447·82	628·96	855·90	1123·23	1405·52	1637·17	1683·53	1336·03	510·28
+ *·75*	245·63	366·56	533·05	755·92	1042·49	1386·41	1743·33	1979·38	1794·82	828·27
+ *·80*	183·35	281·92	424·74	628·49	913·07	1296·13	1772·80	2252·77	2393·94	1404·91
+ *·85*	124·08	196·62	307·09	474·80	728·55	1109·20	1664·80	2407·27	3099·80	2495·12
+ *·90*	70·30	114·82	186·02	300·94	489·11	802·95	1336·07	2244·07	3664·14	4555·85
+ *·95*	25·84	43·51	73·17	124·05	214·20	381·46	712·23	1426·14	3147·79	7414·56
+ *1·00*	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
Mean	·0000	·0921	·1845	·2777	·3720	·4678	·5658	·6667	·7713	·8814
Mode	·0000	·1813	·3484	·4919	·6106	·7087	·7894	·8563	·9122	·9595
σ	·4082	·4055	·3973	·3832	·3629	·3356	·3001	·2545	·1958	·1175
$(1-\rho^2)/\sqrt{n-1}$	·4082	·4042	·3919	·3715	·3429	·3062	·2613	·2082	·1470	·0776
β_1	·0000	·0288	·1186	·2798	·5340	·9222	1·5263	2·5318	4·4611	9·6408
β_2	2·2500	2·2929	2·4267	2·6686	3·0535	3·6503	4·5968	6·2238	9·5129	19·3424

TABLE A. *Ordinates and Constants of Frequency Curves.*

$n = 8$. ρ variate (correlation in population sampled).

r variate (correlation in sample).	*0*	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*	*·7*	*·8*	*·9*
− *1·00*	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
− *·95*	8·91	4·76	2·49	1·25	·59	·26	·10	·03	·01	·00
− *·90*	33·84	18·63	9·97	5·12	2·47	1·10	·42	·13	·03	·00
− *·85*	72·19	40·95	22·48	11·80	5·82	2·62	1·03	·33	·07	·01
− *·80*	121·50	71·02	40·02	21·48	10·80	4·95	1·98	·63	·13	·01
− *·75*	179·44	108·11	62·53	34·34	17·61	8·22	3·33	1·08	·23	·02
− *·70*	243·84	151·45	89·96	50·58	26·48	12·58	5·19	1·71	·38	·03
− *·65*	312·66	200·21	122·17	70·35	37·63	18·23	7·66	2·57	·57	·05
− *·60*	384·00	253·56	158·99	93·82	51·30	25·35	10·84	3·69	·83	·07
− *·55*	456·10	310·59	200·22	121·13	67·75	34·18	14·89	5·16	1·18	·10
− *·50*	527·34	370·40	245·57	152·40	87·25	44·96	19·98	7·06	1·64	·14
− *·45*	596·26	432·05	294·69	187·72	110·08	58·00	26·31	9·47	2·25	·19
− *·40*	661·50	494·55	347·19	227·13	136·53	73·61	34·12	12·53	3·03	·27
− *·35*	721·88	556·91	402·57	270·64	166·89	92·15	43·68	16·38	4·04	·36
− *·30*	776·34	618·14	460·28	318·19	201·43	114·03	55·33	21·22	5·34	·49
− *·25*	823·97	677·22	519·66	369·65	240·45	139·67	69·47	27·27	7·03	·66
− *·20*	864·00	733·11	579·99	424·79	284·17	169·57	86·55	34·83	9·19	·88
− *·15*	895·79	784·83	640·42	483·31	332·81	204·24	107·11	44·26	11·98	1·17
− *·10*	918·84	831·37	700·04	544·75	386·52	244·24	131·79	56·00	15·57	1·57
− *·05*	932·82	871·77	757·84	608·54	445·36	290·13	161·34	70·61	20·22	2·09
·00	937·50	905·10	812·68	673·93	509·27	342·52	196·61	88·81	26·24	2·80
+ *·05*	932·82	930·49	863·38	740·00	578·06	401·96	238·59	111·47	34·07	3·77
+ *·10*	918·84	947·15	908·63	805·60	651·31	468·99	288·43	139·69	44·29	5·08
+ *·15*	895·79	954·37	947·08	869·36	728·36	544·03	347·39	174·87	57·69	6·89
+ *·20*	864·00	951·55	977·31	929·66	808·23	627·31	416·87	218·74	75·35	9·42
+ *·25*	823·97	938·24	997·87	984·60	889·50	718·81	498·39	273·48	98·76	12·97
+ *·30*	776·34	914·13	1007·32	1031·99	970·27	818·08	593·47	341·77	129·97	18·05
+ *·35*	721·88	879·12	1004·28	1069·38	1048·02	924·04	703·52	426·94	171·88	25·40
+ *·40*	661·50	833·34	987·47	1094·05	1119·51	1034·75	829·63	532·99	228·55	36·23
+ *·45*	596·26	777·15	955·78	1103·06	1180·66	1147·03	972·16	664·66	305·76	52·50
+ *·50*	527·34	711·26	908·44	1093·37	1226·48	1256·06	1130·10	827·21	411·69	77·48
+ *·55*	456·10	636·70	845·06	1061·99	1251·03	1354·86	1300·15	1025·98	558·02	116·83
+ *·60*	384·00	554·91	765·85	1006·21	1247·49	1433·64	1475·18	1265·10	761·16	180·59
+ *·65*	312·66	467·80	671·79	924·01	1208·46	1479·32	1642·00	1544·83	1043·60	287·38
+ *·70*	243·84	377·81	564·92	814·59	1126·64	1475·21	1778·44	1856·10	1434·02	473·04
+ *·75*	179·44	287·97	448·65	679·20	996·09	1401·54	1849·45	2169·84	1962·40	809·47
+ *·80*	121·50	202·00	328·13	522·33	814·61	1237·97	1804·24	2418·01	2637·69	1445·38
+ *·85*	72·19	124·36	210·79	353·40	587·92	970·50	1578·45	2464·22	3372·91	2684·78
+ *·90*	33·84	60·42	106·94	189·15	336·77	607·69	1116·43	2080·31	3769·68	5016·00
+ *·95*	8·91	16·49	30·50	57·02	109·05	216·63	456·02	1045·85	2706·04	7661·16
+ *1·00*	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
Mean	·0000	·0932	·1867	·2808	·3759	·4725	·5709	·6718	·7760	·8847
Mode	·0000	·1613	·3135	·4505	·5698	·6722	·7594	·8338	·8975	·9524
σ	·3780	·3753	·3673	·3536	·3339	·3074	·2733	·2299	·1746	·1024
$(1-\rho^2)/\sqrt{n-1}$	·3780	·3742	·3628	·3439	·3175	·2835	·2419	·1928	·1361	·0718
β_1	·0000	·0272	·1117	·2630	·5000	·8586	1·4088	2·3044	3·9581	8·0434
β_2	2·3333	2·3751	2·5051	2·7393	3·1101	3·6800	4·5751	6·0839	9·0368	17·2512

TABLE A—(*continued*).

$n = 9$. ρ variate (correlation in population sampled).

r variate (correlation in sample).	*0*	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*	*·7*	*·8*	*·9*
– *1·00*	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
– *·95*	3·02	1·47	·69	·31	·13	·05	·02	·00	·00	—
– *·90*	16·03	8·06	3·92	1·82	·79	·31	·10	·03	·00	—
– *·85*	41·32	21·50	10·78	5·14	2·28	·91	·31	·08	·01	—
– *·80*	79·21	42·66	22·04	10·78	4·89	2·00	·70	·19	·03	—
– *·75*	128·96	71·93	38·30	19·23	8·93	3·72	1·32	·37	·06	·00
– *·70*	189·20	109·29	60·01	30·95	14·72	6·27	2·27	·64	·11	·01
– *·65*	258·15	154·47	87·49	46·39	22·61	9·85	3·64	1·04	·19	·01
– *·60*	333·77	206·90	120·93	65·95	32·98	14·69	5·55	1·62	·29	·02
– *·55*	413·87	265·84	160·41	90·03	46·21	21·08	8·14	2·42	·45	·03
– *·50*	496·20	330·31	205·86	118·99	62·73	29·33	11·58	3·52	·66	·04
– *·45*	578·53	399·18	257·08	153·13	83·00	39·81	16·09	4·99	·96	·06
– *·40*	658·72	471·20	313·71	192·70	107·46	52·93	21·93	6·97	1·37	·09
– *·35*	734·71	544·95	375·25	237·86	136·60	69·16	29·41	9·57	1·93	·12
– *·30*	804·64	618·94	441·03	288·69	170·90	89·03	38·90	12·99	2·68	·17
– *·25*	866·82	691·61	510·20	345·14	210·81	113·15	50·86	17·45	3·70	·25
– *·20*	919·77	761·33	581·74	407·03	256·77	142·16	65·83	23·24	5·06	·35
– *·15*	962·26	826·48	654·46	473·98	309·16	176·78	84·46	30·73	6·89	·48
– *·10*	993·32	885·42	726·99	545·46	368·27	217·80	107·54	40·41	9·36	·68
– *·05*	1012·24	936·57	797·78	620·65	434·27	266·02	135·99	52·88	12·66	·95
·00	1018·59	978·46	865·14	698·50	507·13	322·29	170·89	68·91	17·11	1·33
+ *·05*	1012·24	1009·68	927·20	777·65	586·61	387·41	213·52	89·51	23·11	1·86
+ *·10*	993·32	1029·05	982·02	856·41	672·14	462·13	265·33	115·94	31·22	2·63
+ *·15*	962·26	1035·54	1027·55	932·73	762·75	547·03	327·98	149·85	42·24	3·73
+ *·20*	919·77	1028·41	1061·74	1004·19	856·97	642·43	403·32	193·30	57·27	5·33
+ *·25*	866·82	1007·20	1082·54	1068·00	952·68	748·20	493·28	248·93	77·88	7·67
+ *·30*	804·64	971·79	1088·08	1121·01	1047·05	863·56	599·83	320·04	106·28	11·16
+ *·35*	734·71	922·48	1076·68	1159·76	1136·34	986·80	724·70	410·75	145·67	16·43
+ *·40*	658·72	859·99	1047·01	1180·62	1215·85	1114·86	869·09	526·05	200·65	24·55
+ *·45*	578·53	785·54	998·27	1179·91	1279·81	1242·93	1032·99	671·79	277·86	37·28
+ *·50*	496·20	700·85	930·34	1154·15	1321·44	1363·83	1214·32	854·38	386·97	57·71
+ *·55*	413·87	608·22	843·95	1100·46	1333·12	1467·50	1407·47	1079·97	541·89	91·38
+ *·60*	333·77	510·46	740·94	1016·99	1306·81	1540·47	1601·27	1352·44	762·41	148·52
+ *·65*	258·15	410·96	624·47	903·63	1234·97	1565·77	1776·21	1669·36	1075·58	248·83
+ *·70*	189·20	313·58	499·21	762·81	1111·97	1523·66	1901·22	2014·01	1515·00	431·66
+ *·75*	128·96	222·57	371·51	600·46	936·53	1394·27	1930·95	2341·13	2111·97	778·77
+ *·80*	79·21	142·39	249·41	427·14	715·16	1163·62	1807·20	2554·55	2860·84	1463·91
+ *·85*	41·32	77·38	142·36	258·83	466·86	835·66	1472·97	2482·96	3612·89	2844·14
+ *·90*	16·03	31·28	60·49	116·98	228·19	452·62	918·20	1898·32	3818·02	5437·47
+ *·95*	3·02	6·15	12·51	25·79	54·64	121·08	287·39	755·00	2290·26	7794·37
+ *1·00*	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
Mean	·0000	·0940	·1883	·2832	·3789	·4760	·5747	·6756	·7793	·8869
Mode	·0000	·1492	·2920	·4238	·5420	·6463	·7374	·8168	·8861	·9467
σ	·3536	·3510	·3431	·3298	·3107	·2852	·2524	·2109	·1586	·0915
$(1-\rho^2)/\sqrt{n-1}$	·3536	·3500	·3394	·3217	·2670	·2652	·2263	·1803	·1273	·0672
β_1	·0000	·0256	·1051	·2468	·4677	·7983	1·2989	2·0963	3·5152	6·7561
β_2	2·4000	2·4403	2·5657	2·7907	3·1456	3·6857	4·5239	5·9099	8·5326	15·3136

TABLE A. *Ordinates and Constants of Frequency Curves.*

$n = 10$. ρ variate (correlation in population sampled).

r variate (correlation in sample).

	0	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*	*·7*	*·8*	*·9*
− *1·00*	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
− *·95*	1·01	·45	·19	·08	·03	·01	·00	·00	—	—
− *·90*	7·50	3·44	1·53	·64	·25	·09	·03	·01	—	—
− *·85*	23·37	11·15	5·11	2·21	·88	·31	·09	·02	·00	—
− *·80*	51·03	25·33	12·00	5·34	2·19	·80	·24	·06	·01	—
− *·75*	91·59	47·29	23·18	10·64	4·47	1·67	·52	·12	·02	—
− *·70*	145·09	77·94	39·56	18·72	8·09	3·09	·98	·23	·03	—
− *·65*	210·66	117·77	61·92	30·23	13·43	5·25	1·71	·42	·06	—
− *·60*	286·72	166·85	90·90	45·82	20·95	8·41	2·81	·70	·10	·00
− *·55*	371·15	224·86	127·01	66·13	31·14	12·85	4·39	1·12	·17	·01
− *·50*	461·43	291·10	170·55	91·82	44·57	18·91	6·63	1·73	·26	·01
− *·45*	554·77	364·50	221·63	123·45	61·84	27·00	9·73	2·60	·41	·02
− *·40*	648·27	443·69	280·14	161·56	83·58	37·60	13·93	3·83	·61	·03
− *·35*	739·03	526·99	345·68	206·59	110·50	51·29	19·56	5·52	·91	·04
− *·30*	824·22	612·48	417·62	258·84	143·28	68·70	27·02	7·85	1·33	·06
− *·25*	901·22	698·04	495·03	318·47	182·65	90·58	36·79	11·03	1·92	·09
− *·20*	967·68	781·38	576·65	385·42	229·29	117·77	49·48	15·32	2·76	·13
− *·15*	1021·57	860·14	660·97	459·39	283·82	151·22	65·82	21·09	3·92	·20
− *·10*	1061·26	931·94	746·13	539·76	346·77	191·94	86·73	28·82	5·55	·29
− *·05*	1085·57	994·42	830·01	625·59	418·49	241·06	113·28	39·13	7·83	·42
·00	1093·75	1045·39	910·20	715·49	499·09	299·70	146·80	52·84	11·02	·62
+ *·05*	1085·57	1082·81	984·11	807·66	588·33	369·02	188·84	71·03	15·49	·91
+ *·10*	1061·26	1104·96	1048·94	899·79	685·53	450·06	241·23	95·11	21·75	1·35
+ *·15*	1021·57	1110·49	1101·85	989·04	789·44	543·65	306·06	126·91	30·57	1·99
+ *·20*	967·68	1098·49	1139·99	1072·04	898·05	650·25	385·66	168·83	43·03	2·98
+ *·25*	901·22	1068·59	1160·70	1144·96	1008·47	769·73	482·55	223·95	60·70	4·48
+ *·30*	824·22	1021·01	1161·60	1203·51	1116·77	900·98	599·22	296·23	85·91	6·82
+ *·35*	739·03	956·66	1140·83	1243·14	1217·79	1041·59	737·88	390·62	122·04	10·51
+ *·40*	648·27	877·13	1097·21	1259·23	1305·16	1187·27	899·90	513·21	174·12	16·44
+ *·45*	554·77	784·74	1030·51	1247·45	1371·20	1331·27	1084·96	671·18	249·62	26·17
+ *·50*	461·43	682·54	941·67	1204·17	1407·27	1463·74	1289·77	872·31	359·56	42·50
+ *·55*	371·15	574·23	833·02	1127·09	1404·16	1571·18	1506·11	1123·76	520·21	70·66
+ *·60*	286·72	464·10	708·50	1015·97	1353·14	1636·20	1718·18	1429·27	754·96	120·77
+ *·65*	210·66	356·82	573·73	873·46	1247·48	1638·20	1899·37	1783·34	1095·94	213·01
+ *·70*	145·09	257·23	436·02	706·04	1084·83	1555·63	2009·23	2160·46	1582·39	389·45
+ *·75*	91·59	170·01	304·07	524·71	870·38	1371·13	1993·01	2497·22	2247·23	740·79
+ *·80*	51·03	99·20	187·37	345·25	620·62	1081·22	1789·53	2668·18	3067·85	1466·04
+ *·85*	23·37	47·59	95·03	187·37	366·47	711·33	1358·89	2473·52	3826·37	2979·24
+ *·90*	7·50	16·01	33·82	71·51	152·84	333·27	746·59	1712·69	3823·56	5828·60
+ *·95*	1·01	2·27	5·07	11·53	27·06	66·90	179·06	538·90	1916·67	7841·74
+ *1·00*	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
Mean	·0000	·0946	·1896	·2850	·3813	·4787	·5776	·6785	·7819	·8887
Mode	·0000	·1411	·2774	·4050	·5219	·6270	·7206	·8036	·8771	·9422
σ	·3333	·3308	·3232	·3103	·2917	·2671	·2355	·1958	·1461	·0832
$(1-\rho^2)/\sqrt{n-1}$	·3333	·3300	·3200	·3033	·2800	·2500	·2133	·1700	·1200	·0633
β_1	·0000	·0242	·0989	·2317	·4374	·7431	1·2002	1·9122	3·1377	5·7475
β_2	2·4545	2·4933	2·6137	2·8292	3·1669	3·6774	4·4598	5·7290	8·0534	13·6667

TABLE A—(*continued*).

$n = 11$. ρ variate (correlation in population sampled).

r variate (correlation in sample).	*0*	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*	*·7*	*·8*	*·9*
− 1·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
− ·95	·34	·14	·05	·02	·01	·00	·00	—	—	—
− ·90	3·48	1·46	·59	·22	·08	·02	·01	·00	—	—
− ·85	13·10	5·73	2·40	·94	·34	·11	·03	·01	—	—
− ·80	32·59	14·90	6·47	2·63	·97	·31	·08	·02	—	—
− ·75	64·48	30·82	13·91	5·84	2·22	·74	·20	·04	·00	—
− ·70	110·28	55·10	25·85	11·22	4·40	1·51	·42	·09	·01	—
− ·65	170·38	89·00	43·43	19·52	7·90	2·78	·80	·17	·02	—
− ·60	244·13	133·37	67·72	31·55	13·19	4·77	1·41	·30	·04	—
− ·55	329·31	188·52	99·67	48·15	20·80	7·76	2·35	·51	·06	—
− ·50	425·31	254·27	140·04	70·22	31·39	12·08	3·76	·84	·10	·00
− ·45	527·29	329·89	189·38	98·64	45·66	18·15	5·83	1·34	·17	·01
− ·40	632·37	414·10	247·94	134·25	64·43	26·48	8·77	2·08	·27	·01
− ·35	736·81	505·13	315·62	177·84	88·59	37·70	12·90	3·16	·43	·01
− ·30	836·83	600·74	391·97	230·03	119·07	52·54	18·61	4·71	·65	·02
− ·25	928·73	698·31	476·06	291·27	156·85	71·87	26·38	6·91	·99	·03
− ·20	1009·12	794·88	566·57	361·75	202·94	96·71	36·86	10·01	1·49	·05
− ·15	1074·98	887·29	661·66	441·31	258·26	128·20	50·84	14·35	2·21	·08
− ·10	1123·87	972·26	759·03	529·42	323·64	167·66	69·32	20·37	3·27	·12
− ·05	1153·95	1046·54	855·92	625·00	399·73	216·51	93·53	28·70	4·80	·19
·00	1164·10	1107·05	949·18	726·44	486·84	276·25	124·99	40·16	7·04	·29
+ ·05	1153·95	1150·99	1035·30	831·45	584·86	348·45	165·55	55·88	10·29	·44
+ ·10	1123·87	1176·02	1110·55	937·05	693·05	434·44	217·39	77·34	15·02	·68
+ ·15	1074·98	1180·37	1171·11	1039·52	809·89	535·54	283·09	106·54	21·93	1·06
+ ·20	1009·12	1163·01	1213·24	1134·42	932·85	652·40	365·55	146·17	32·04	1·65
+ ·25	928·73	1123·74	1233·55	1216·69	1058·17	784·94	467·92	199·73	46·90	2·60
+ ·30	836·83	1063·29	1229·19	1280·75	1180·68	931·80	593·39	271·79	68·83	4·13
+ ·35	736·81	983·38	1198·19	1320·82	1293·66	1089·82	744·74	368·23	101·35	6·67
+ ·40	632·37	886·74	1139·72	1331·30	1388·77	1253·34	923·68	496·34	149·79	10·92
+ ·45	527·29	777·05	1054·45	1307·30	1456·28	1413·46	1129·63	664·75	222·30	18·21
+ ·50	425·31	658·86	944·78	1245·35	1485·58	1557·29	1358·02	882·89	331·21	31·02
+ ·55	329·91	537·38	815·03	1144·27	1466·08	1667·54	1597·69	1159·22	495·09	54·17
+ ·60	244·13	418·24	671·55	1006·07	1388·90	1722·77	1827·66	1497·43	741·14	97·35
+ ·65	170·38	307·09	522·51	836·93	1249·15	1699·11	2013·49	1888·67	1107·09	180·79
+ ·70	110·28	209·16	377·49	647·80	1049·15	1574·50	2105·04	2297·63	1638·62	348·37
+ ·75	64·48	128·73	246·69	454·52	801·88	1336·70	2039·33	2640·85	2370·71	698·67
+ ·80	32·59	68·50	139·53	276·64	533·90	995·96	1756·78	2762·99	3261·77	1455·70
+ ·85	13·10	29·01	62·88	134·46	285·17	600·28	1242·87	2443·04	4017·99	3094·34
+ ·90	3·48	8·12	18·74	43·33	101·48	243·28	601·85	1532·03	3796·61	6195·13
+ ·95	·34	·83	2·04	5·11	13·29	36·65	110·61	381·37	1590·43	7823·00
+ 1·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
Mean	·0000	·0952	·1906	·2865	·3831	·4808	·5799	·6807	·7839	·8900
Mode	·0000	·1352	·2667	·3912	·5066	·6121	·7074	·7930	·8697	·9384
σ	·3162	·3138	·3064	·2938	·2758	·2519	·2214	·1833	·1360	·0767
$(1-\rho^2)/\sqrt{n-1}$	·3162	·3131	·3036	·2878	·2656	·2372	·2024	·1613	·1138	·0601
β_1	·0000	·0228	·0932	·2179	·4101	·6933	1·1112	1·7516	2·8193	4·9565
β_2	2·5000	2·5372	2·6527	2·8587	3·1798	3·6616	4·3914	5·5540	7·6188	12·2879

TABLE A. *Ordinates and Constants of Frequency Curves.*

$n = 12$. ρ variate (correlation in population sampled).

r variate (correlation in sample).

	0	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*	*·7*	*·8*	*·9*
− *1·00*	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
− *·95*	·11	·04	·01	·00	·00	·00	—	—	—	—
− *·90*	1·60	·61	·22	·08	·02	·01	·00	—	—	—
− *·85*	7·30	2·93	1·12	·40	·13	·04	·01	—	—	—
− *·80*	20·67	8·71	3·47	1·28	·43	·12	·03	·00	—	—
− *·75*	45·08	19·94	8·29	3·18	1·10	·33	·08	·01	—	—
− *·70*	83·24	38·68	16·77	6·68	2·38	·73	·18	·03	·00	—
− *·65*	136·86	66·80	30·25	12·52	4·62	1·46	·37	·07	·01	—
− *·60*	206·44	105·87	50·10	21·57	8·24	2·69	·70	·13	·01	—
− *·55*	291·24	156·97	77·68	34·81	13·80	4·65	1·25	·23	·02	—
− *·50*	389·33	220·58	114·20	53·33	21·95	7·66	2·12	·41	·04	—
− *·45*	497·73	296·51	160·71	78·27	33·48	12·11	3·46	·69	·07	—
− *·40*	612·62	383·82	217·93	110·79	49·33	18·52	5·48	1·13	·12	—
− *·35*	729·56	480·84	286·20	152·04	70·53	27·52	8·45	1·80	·20	·00
− *·30*	843·79	585·17	365·35	203·01	98·26	39·90	12·72	2·80	·32	·01
− *·25*	950·51	693·78	454·68	264·55	133·77	56·63	18·79	4·30	·51	·01
− *·20*	1045·09	803·05	552·83	337·18	178·37	78·86	27·27	6·49	·80	·02
− *·15*	1123·41	908·99	657·79	421·03	233·38	107·94	39·00	9·69	1·24	·03
− *·10*	1181·98	1007·35	766·83	515·70	299·98	145·45	55·03	14·30	1·91	·05
− *·05*	1218·21	1093·82	876·57	620·13	379·19	193·12	76·70	20·91	2·93	·08
·00	1230·47	1164·30	983·02	732·48	471·64	252·88	105·70	30·32	4·46	·13
+ *·05*	1218·21	1215·06	1081·67	850·05	577·41	326·69	144·13	43·65	6·79	·21
+ *·10*	1181·98	1243·05	1167·70	969·15	695·83	416·49	194·57	62·45	10·30	·34
+ *·15*	1123·41	1246·03	1236·18	1085·08	825·16	523·93	260·05	88·83	15·62	·56
+ *·20*	1045·09	1222·86	1282·35	1192·20	962·35	650·07	344·11	125·68	23·70	·91
+ *·25*	950·51	1173·63	1301·99	1284·05	1102·71	794·98	450·63	176·90	35·99	1·49
+ *·30*	843·79	1099·72	1291·80	1353·61	1239·72	957·09	583·60	247·67	54·78	2·49
+ *·35*	729·56	1003·91	1249·80	1393·76	1364·85	1132·50	746·54	344·77	83·60	4·20
+ *·40*	612·62	890·31	1175·76	1397·87	1467·64	1314·07	941·64	476·75	127·99	7·20
+ *·45*	497·73	764·16	1071·56	1360·66	1536·09	1490·50	1168·15	653·92	196·63	12·58
+ *·50*	389·33	631·64	941·41	1279·15	1557·56	1645·55	1420·17	887·55	303·03	22·49
+ *·55*	291·24	499·45	791·98	1153·78	1520·32	1757·80	1683·36	1187·72	468·00	41·25
+ *·60*	206·44	374·33	632·17	989·48	1415·90	1801·62	1930·97	1558·25	722·68	77·95
+ *·65*	136·86	262·47	472·60	796·46	1242·33	1750·35	2120·06	1986·75	1110·84	152·41
+ *·70*	83·24	168·90	324·59	590·32	1007·76	1582·81	2190·55	2427·07	1685·48	309·54
+ *·75*	45·08	96·80	198·77	391·03	733·76	1294·33	2072·67	2774·00	2484·25	654·55
+ *·80*	20·67	46·98	103·20	220·15	456·19	911·23	1713·02	2842·00	3444·82	1435·84
+ *·85*	7·30	17·56	41·32	95·84	220·41	503·13	1129·13	2396·80	4191·11	3192·59
+ *·90*	1·60	4·09	10·31	26·08	66·93	176·39	481·91	1361·28	3744·80	6541·18
+ *·95*	·11	·30	·81	2·25	6·48	19·94	67·87	268·10	1310·98	7752·85
+ *1·00*	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
Mean	·0000	·0956	·1914	·2877	·3847	·4826	·5818	·6826	·7855	·8910
Mode	·0000	·1309	·2586	·3805	·4948	·6004	·6968	·7843	·8636	·9353
σ	·3015	·2991	·2919	·2797	·2622	·2390	·2096	·1729	·1276	·0714
$(1-\rho^2)/\sqrt{n-1}$	·3015	·2985	·2895	·2744	·2533	·2261	·1930	·1538	·1085	·0573
β_1	·0000	·0215	·0880	·2054	·3854	·6487	1·0329	1·6118	2·5509	4·3322
β_2	2·5385	2·5742	2·6848	2·8816	3·1870	3·6417	4·3231	5·3905	7·2330	11·1595

TABLE A—(*continued*).

$n = 13$. ρ variate (correlation in population sampled).

r variate (correlation in sample).	*0*	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*	*·7*	*·8*	*·9*
− *1·00*	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
− *·95*	·04	·01	·00	·00	·00	—	—	—	—	—
− *·90*	·73	·26	·09	·03	·01	·00	—	—	—	—
− *·85*	4·04	1·49	·52	·17	·05	·01	·00	—	—	—
− *·80*	13·03	5·06	1·85	·62	·19	·05	·01	—	—	—
− *·75*	31·34	12·84	4·91	1·72	·54	·14	·03	·00	—	—
− *·70*	62·49	27·00	10·82	3·95	1·28	·35	·08	·01	—	—
− *·65*	109·33	49·86	20·96	7·99	2·69	·76	·17	·03	—	—
− *·60*	173·60	83·57	36·87	14·67	5·13	1·51	·35	·05	·00	—
− *·55*	255·68	129·97	60·20	25·03	9·10	2·78	·66	·11	·01	—
− *·50*	354·43	190·29	92·61	40·28	15·26	4·83	1·19	·20	·02	—
− *·45*	467·24	265·03	135·62	61·76	24·42	8·04	2·05	·35	·03	—
− *·40*	590·21	353·79	190·50	90·93	37·56	12·88	3·41	·61	·05	—
− *·35*	718·39	455·19	258·08	129·26	55·84	19·97	5·50	1·01	·09	—
− *·30*	846·13	566·86	338·63	178·18	80·64	30·14	8·65	1·66	·15	—
− *·25*	967·43	685·47	431·85	238·96	113·45	44·38	13·30	2·66	·26	·00
− *·20*	1076·39	806·84	536·45	312·55	155·92	63·95	20·07	4·19	·42	·01
− *·15*	1167·55	926·10	650·33	399·46	209·73	90·38	29·75	6·51	·69	·01
− *·10*	1236·25	1037·95	770·44	499·56	276·51	125·48	43·44	9·98	1·11	·02
− *·05*	1278·96	1136·93	892·78	611·89	357·72	171·31	62·54	15·15	1·77	·04
·00	1293·45	1217·76	1012·46	734·51	454·39	230·21	88·89	22·76	2·82	·06
+ *·05*	1278·96	1275·64	1123·90	864·29	566·93	304·67	124·80	33·91	4·45	·10
+ *·10*	1236·25	1306·66	1221·04	996·83	694·79	397·09	173·18	50·15	7·03	·17
+ *·15*	1167·55	1308·10	1297·68	1126·41	836·11	509·76	237·58	73·66	11·07	·29
+ *·20*	1076·39	1278·72	1347·93	1246·04	987·33	644·20	322·16	107·48	17·43	·50
+ *·25*	967·43	1218·98	1366·66	1347·76	1142·82	800·73	431·61	155·83	27·47	·86
+ *·30*	846·13	1131·13	1350·13	1422·76	1294·58	977·68	570·83	224·46	43·35	1·49
+ *·35*	718·39	1019·23	1296·48	1462·65	1432·08	1170·41	744·26	321·04	68·58	2·63
+ *·40*	590·21	888·97	1206·29	1459·72	1542·51	1370·21	954·71	455·44	108·77	4·72
+ *·45*	467·24	747·35	1082·96	1408·44	1611·41	1563·16	1201·40	639·76	172·98	8·65
+ *·50*	354·43	602·21	932·90	1306·67	1624·11	1729·32	1477·09	887·39	275·75	16·22
+ *·55*	255·68	461·64	765·35	1157·00	1567·94	1842·84	1763·97	1210·31	440·01	31·24
+ *·60*	173·60	333·18	591·84	967·83	1435·55	1873·82	2029·03	1612·76	700·88	62·08
+ *·65*	109·33	223·11	425·11	753·80	1228·80	1793·32	2220·16	2078·63	1108·60	127·80
+ *·70*	62·49	135·64	277·57	534·99	962·72	1582·52	2267·17	2549·96	1724·34	273·57
+ *·75*	31·34	72·39	159·28	334·58	667·77	1246·49	2095·16	2898·15	2589·24	609·94
+ *·80*	13·03	32·04	75·91	174·24	387·67	829·19	1661·34	2907·54	3618·62	1408·68
+ *·85*	4·04	10·58	27·01	67·94	169·42	419·43	1020·26	2338·80	4348·30	3276·40
+ *·90*	·73	2·05	5·65	15·61	43·90	127·20	383·80	1203·06	3673·97	6869·84
+ *·95*	·04	·11	·32	·98	3·14	10·79	41·42	187·46	1074·87	7642·57
+ *1·00*	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
Mean	·0000	·0960	·1921	·2887	·3859	·4841	·5834	·6841	·7868	·8919
Mode	·0000	·1274	·2522	·3721	·4853	·5908	·6880	·7772	·8585	·9326
σ	·2887	·2863	·2793	·2674	·2504	·2279	·1994	·1640	·1206	·0671
$(1-\rho^2)/\sqrt{n-1}$	·2887	·2858	·2771	·2627	·2425	·2165	·1848	·1472	·1039	·0548
β_1	·0000	·0204	·0833	·1941	·3631	·6087	·9636	1·4902	2·3236	3·8337
β_2	2·5714	2·6057	2·7117	2·8999	3·1904	3·6201	4·2575	5·2404	6·8937	10·2454

TABLE A *Ordinates and Constants of Frequency Curves.*

$n = 14$. ρ variate (correlation in population sampled).

r variate (correlation in sample).	*0*	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*	*·7*	*·8*	*·9*
− *1·00*	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
− *·95*	·01	·00	·00	·00	—	—	—	—	—	—
− *·90*	·34	·11	·03	·01	·00	—	—	—	—	—
− *·85*	2·23	·75	·24	·07	·02	·00	—	—	—	—
− *·80*	8·18	2·93	·98	·30	·08	·02	·00	—	—	—
− *·75*	21·69	8·22	2·90	·93	·26	·06	·01	—	—	—
− *·70*	46·70	18·77	6·95	2·33	·69	·17	·03	·00	—	—
− *·65*	86·94	37·04	14·45	5·07	1·55	·40	·08	·01	—	—
− *·60*	145·33	65·68	27·00	9·93	3·17	·84	·17	·02	—	—
− *·55*	223·45	107·13	46·44	17·91	5·98	1·65	·35	·05	·00	—
− *·50*	321·20	163·42	74·76	30·28	10·57	3·04	·66	·09	·01	—
− *·45*	436·63	235·83	113·94	48·51	17·73	5·31	1·21	·18	·01	—
− *·40*	566·06	324·64	165·76	74·28	28·46	8·92	2·11	·32	·02	—
− *·35*	704·20	428·97	231·67	109·39	44·02	14·43	3·57	·57	·04	—
− *·30*	844·64	546·64	312·50	155·68	65·88	22·66	5·86	·98	·07	—
− *·25*	980·21	674·21	408·32	214·86	95·78	34·62	9·38	1·64	·13	—
− *·20*	1103·62	806·97	518·19	288·41	135·67	51·63	14·70	2·69	·23	·00
− *·15*	1207·94	939·26	640·05	377·28	187·62	75·34	22·59	4·35	·38	·01
− *·10*	1287·18	1064·65	770·57	481·74	253·73	107·76	34·14	6·94	·64	·01
− *·05*	1336·68	1176·41	905·17	601·04	335·93	151·28	50·77	10·92	1·07	·02
·00	1353·52	1267·92	1038·07	733·22	435·79	208·62	74·41	17·01	1·77	·03
+ *·05*	1336·68	1333·18	1162·50	874·80	554·12	282·80	107·57	26·23	2·91	·05
+ *·10*	1287·18	1367·32	1271·05	1020·68	690·62	376·89	153·45	40·10	4·77	·09
+ *·15*	1207·94	1367·06	1356·11	1164·04	843·38	493·74	216·07	60·80	7·81	·15
+ *·20*	1103·62	1331·09	1410·48	1296·43	1008·40	635·51	300·25	91·50	12·76	·27
+ *·25*	980·21	1260·37	1428·09	1408·13	1179·07	802·90	411·53	136·65	20·87	·49
+ *·30*	844·64	1158·20	1404·74	1488·72	1345·78	994·23	555·84	202·51	34·16	·89
+ *·35*	704·20	1030·12	1338·84	1528·05	1495·87	1204·16	738·66	297·60	56·01	1·64
+ *·40*	566·06	883·63	1232·03	1517·46	1613·92	1422·35	963·63	433·15	92·02	3·08
+ *·45*	436·63	727·61	1089·56	1451·35	1682·84	1632·02	1230·08	623·12	151·50	5·92
+ *·50*	321·20	571·57	920·31	1328·79	1685·90	1809·23	1529·42	883·27	249·81	11·64
+ *·55*	223·45	424·77	736·29	1155·02	1609·82	1923·36	1840·21	1227·85	411·85	23·56
+ *·60*	145·33	295·23	551·59	942·42	1448·96	1940·22	2122·58	1661·76	676·71	49·22
+ *·65*	86·94	188·79	380·68	710·22	1209·98	1829·15	2314·64	2165·10	1101·47	106·69
+ *·70*	46·70	108·45	236·30	482·68	915·58	1575·19	2336·05	2667·21	1756·31	240·71
+ *·75*	21·69	53·89	127·07	284·99	605·00	1195·09	2108·50	3014·47	2686·77	565·87
+ *·80*	8·18	21·76	55·58	137·29	327·97	751·18	1604·06	2961·44	3784·47	1375·97
+ *·85*	2·23	6·34	17·57	47·94	129·65	348·10	917·81	2272·14	4491·55	3347·70
+ *·90*	·34	1·02	3·08	9·30	28·67	91·32	304·31	1058·56	3588·66	7183·43
+ *·95*	·01	·04	·13	·43	1·52	5·81	25·17	130·49	877·42	7501·01
+ *1·00*	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
Mean	·0000	·0963	·1927	·2896	·3870	·4853	·5847	·6854	·7879	·8926
Mode	·0000	·1246	·2470	·3652	·4775	·5828	·6808	·7711	·8541	·9303
σ	·2774	·2751	·2682	·2566	·2401	·2182	·1906	·1564	·1145	·0634
$(1-\rho^2)/\sqrt{n-1}$	·2774	·2746	·2663	·2524	·2330	·2080	·1775	·1414	·0998	·0527
β_1	·0000	·0194	·0790	·1838	·3430	·5729	·9020	1·3838	2·1298	3·4290
β_2	2·6000	2·6329	2·7346	2·9145	3·1912	3·5979	4·1955	5·1038	6·5961	9·4886

TABLE A—(*continued*).

$n = 15$. ρ variate (correlation in population sampled).

r variate (correlation in sample).	*0*	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*	*·7*	*·8*	*·9*
– 1·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
– ·95	·00	·00	·00	—	—	—	—	—	—	—
– ·90	·15	·04	·01	·00	·00	—	—	—	—	—
– ·85	1·22	·38	·11	·03	·01	·00	—	—	—	—
– ·80	5·12	1·69	·52	·14	·04	·01	—	—	—	—
– ·75	14·96	5·25	1·70	·50	·13	·03	·00	—	—	—
– ·70	34·77	12·99	4·45	1·37	·37	·08	·01	—	—	—
– ·65	68·88	27·42	9·93	3·21	·90	·21	·04	·00	—	—
– ·60	121·21	51·42	19·70	6·69	1·96	·47	·08	·01	—	—
– ·55	194·55	87·97	35·70	12·77	3·91	·97	·18	·02	—	—
– ·50	289·98	139·82	60·13	22·68	7·29	1·90	·37	·05	·00	—
– ·45	406·50	209·05	95·35	37·96	12·82	3·50	·71	·09	·01	—
– ·40	540·85	296·76	143·69	60·46	21·49	6·15	1·30	·17	·01	—
– ·35	687·70	402·73	207·17	92·23	34·56	10·39	2·30	·32	·02	—
– ·30	839·97	525·16	287·27	135·50	53·62	16·97	3·95	·57	·04	—
– ·25	989·42	660·62	384·61	192·47	80·56	26·90	6·59	1·00	·07	—
– ·20	1127·28	804·07	498·68	265·12	117·61	41·52	10·72	1·72	·12	—
– ·15	1245·03	949·02	627·56	354·99	167·21	62·56	17·09	2·90	·21	—
– ·10	1335·15	1087·93	767·80	462·81	231·94	92·19	26·73	4·80	·37	·00
– ·05	1391·74	1212·67	914·28	588·16	314·29	133·08	41·06	7·85	·64	·01
·00	1411·04	1315·18	1060·32	729·17	416·38	188·35	62·06	12·66	1·11	·01
+ *·05*	1391·74	1388·08	1197·90	882·11	539·56	261·56	92·37	20·21	1·89	·02
+ *·10*	1335·15	1425·42	1318·13	1041·17	683·89	356·36	135·46	31·94	3·23	·04
+ *·15*	1245·03	1423·30	1411·83	1198·41	847·52	476·43	195·77	50·00	5·49	·08
+ *·20*	1127·28	1380·40	1470·37	1343·80	1026·06	624·58	278·78	77·60	9·31	·15
+ *·25*	989·42	1298·27	1486·66	1465·74	1211·89	802·05	390·92	119·38	15·80	·28
+ *·30*	839·97	1181·45	1456·06	1551·88	1393·76	1007·27	539·22	182·03	26·81	·53
+ *·35*	687·70	1037·21	1377·39	1590·37	1556·64	1234·25	730·36	274·85	45·57	1·02
+ *·40*	540·85	875·02	1253·60	1571·56	1682·30	1470·94	968·99	410·40	77·56	2·01
+ *·45*	406·50	705·73	1092·09	1489·95	1750·86	1697·55	1254·73	604·65	132·19	4·04
+ *·50*	289·98	540·45	904·49	1346·21	1743·50	1885·77	1577·71	875·91	225·46	8·33
+ *·55*	194·55	389·38	705·68	1148·73	1646·64	1999·91	1912·58	1241·01	384·06	17·70
+ *·60*	121·21	260·61	512·15	914·23	1457·04	2001·47	2212·18	1705·89	650·97	38·88
+ *·65*	68·88	159·16	339·61	666·66	1187·01	1858·75	2404·17	2246·82	1090·34	88·74
+ *·70*	34·77	86·37	200·40	433·86	867·51	1562·05	2398·10	2779·52	1782·27	211·01
+ *·75*	14·96	39·97	100·99	241·85	546·09	1141·54	2114·05	3123·86	2777·70	523·05
+ *·80*	5·12	14·72	40·55	107·77	276·43	677·98	1543·04	3005·21	3943·34	1339·09
+ *·85*	1·22	3·79	11·39	33·71	98·85	287·83	822·59	2199·24	4622·48	3408·02
+ *·90*	·15	·51	1·67	5·52	18·65	65·32	240·39	927·98	3492·48	7483·96
+ *·95*	·00	·01	·05	·19	·73	3·12	15·23	90·51	713·62	7335·23
+ *1·00*	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
Mean	·0000	·0965	·1932	·2903	·3879	·4864	·5858	·6865	·7888	·8932
Mode	·0000	·1224	·2429	·3595	·4710	·5761	·6745	·7659	·8504	·9283
σ	·2673	·2650	·2583	·2470	·2309	·2096	·1828	·1496	·1093	·0602
$(1-\rho^2)/\sqrt{n-1}$	·2673	·2646	·2566	·2423	·2245	·2004	·1710	·1363	·0962	·0508
β_1	·0000	·0184	·0751	·1745	·3248	·5407	·8473	1·2904	1·9635	3·0956
β_2	2·6250	2·6566	2·7542	2·9265	3·1904	3·5759	4·1375	4·9799	6·3347	8·8548

TABLE A. *Ordinates and Constants of Frequency Curves.*

$n = 16$. ρ variate (correlation in population sampled).

r variate (correlation in sample).	*0*	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*	*·7*	*·8*	*·9*
− *1·00*	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
− *·95*	·00	—	—	—	—	—	—	—	—	—
− *·90*	·07	·02	·00	·00	—	—	—	—	—	—
− *·85*	·67	·19	·05	·01	·00	—	—	—	—	—
− *·80*	3·19	·97	·27	·07	·02	·00	—	—	—	—
− *·75*	10·28	3·34	1·00	·27	·06	·01	·00	—	—	—
− *·70*	25·80	8·97	2·84	·80	·19	·04	·01	—	—	—
− *·65*	54·39	20·23	6·80	2·02	·51	·11	·02	—	—	—
− *·60*	100·76	40·12	14·33	4·50	1·20	·26	·04	·00	—	—
− *·55*	168·85	72·01	27·35	9·08	2·55	·57	·09	·01	—	—
− *·50*	260·97	119·24	48·20	16·93	5·01	1·18	·20	·02	—	—
− *·45*	377·23	184·72	79·55	29·61	9·24	2·29	·41	·05	—	—
− *·40*	515·11	270·42	124·16	49·05	16·17	4·23	·80	·09	·00	—
− *·35*	669·43	376·88	184·68	77·51	27·05	7·46	1·48	·18	·01	—
− *·30*	832·67	502·91	263·24	117·56	43·50	12·67	2·65	·34	·02	—
− *·25*	995·53	645·25	361·12	171·85	67·54	20·84	4·61	·61	·03	—
− *·20*	1147·76	798·62	478·36	242·94	101·63	33·28	7·80	1·10	·06	—
− *·15*	1279·16	955·82	613·35	332·95	148·55	51·78	12·89	1·93	·12	—
− *·10*	1380·50	1108·16	762·59	443·20	211·35	78·63	20·86	3·32	·21	—
− *·05*	1444·45	1246·06	920·53	573·72	293·10	116·70	33·10	5·62	·38	—
·00	1466·31	1359·84	1079·59	722·83	396·57	169·51	51·59	9·40	·69	·00
+ *·05*	1444·45	1440·62	1230·45	886·63	523·71	241·10	79·06	15·52	1·23	·01
+ *·10*	1380·50	1481·25	1362·60	1058·69	675·07	335·89	119·19	25·36	2·18	·02
+ *·15*	1279·16	1477·14	1465·15	1229·86	848·97	458·26	176·81	40·99	3·84	·04
+ *·20*	1147·76	1426·97	1527·93	1388·46	1040·70	611·89	258·02	65·60	6·77	·08
+ *·25*	995·53	1333·04	1542·70	1520·86	1241·67	798·66	370·16	103·97	11·92	·16
+ *·30*	832·67	1201·32	1504·45	1612·58	1438·86	1017·24	521·43	163·10	20·98	·31
+ *·35*	669·43	1041·01	1412·54	1649·98	1614·73	1261·08	719·87	253·03	36·96	·63
+ *·40*	515·11	863·74	1271·49	1622·42	1748·02	1516·38	971·31	387·62	65·16	1·30
+ *·45*	377·23	682·33	1091·14	1524·73	1815·85	1760·11	1275·84	584·87	114·98	2·74
+ *·50*	260·97	509·39	886·11	1359·54	1797·36	1959·32	1622·38	865·86	202·85	5·94
+ *·55*	168·85	355·79	674·19	1138·85	1678·96	2072·94	1981·54	1250·36	357·03	13·25
+ *·60*	100·76	229·32	474·01	884·08	1460·52	2058·14	2298·30	1745·69	624·23	30·62
+ *·65*	54·39	133·74	302·02	623·79	1160·78	1882·87	2489·31	2324·29	1075·93	73·57
+ *·70*	25·80	68·58	169·43	388·74	819·36	1544·13	2454·04	2887·46	1802·95	184·41
+ *·75*	10·28	29·55	80·00	204·59	491·36	1086·96	2112·96	3227·08	2862·73	481·97
+ *·80*	3·19	9·92	29·49	84·33	232·25	609·99	1479·67	3040·08	4096·07	1299·15
+ *·85*	·67	2·25	7·36	23·62	75·13	237·24	734·93	2121·99	4742·40	3458·65
+ *·90*	·07	·25	·90	3·27	12·09	46·58	189·31	810·97	3388·31	7772·88
+ *·95*	·00	·00	·02	·08	·35	1·67	9·19	62·58	578·60	7150·91
+ *1·00*	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
Mean	·0000	·0968	·1937	·2909	·3888	·4873	·5868	·6875	·7896	·8937
Mode	·0000	·1206	·2394	·3548	·4655	·5705	·6692	·7614	·8471	·9265
σ	·2582	·2560	·2495	·2384	·2227	·2020	·1759	·1437	·1047	·0575
$(1-\rho^2)/\sqrt{n-1}$	·2582	·2556	·2479	·2350	·2169	·1936	·1652	·1310	·0930	·0491
β_1	·0000	·0176	·0716	·1660	·3083	·5117	·7983	1·2080	1·8195	2·8181
β_2	2·6471	2·6775	2·7712	2·9363	3·1883	3·5545	4·0836	4·8677	6·1046	8·3239

TABLE A—(*continued*).

$n = 17$. ρ variate (correlation in population sampled).

r variate (correlation in sample).	*0*	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*	*·7*	*·8*	*·9*
− *1·00*	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
− *·95*	·00	·00	—	—	—	—	—	—	—	—
− *·90*	·03	·01	·00	—	—	—	—	—	—	—
− *·85*	·37	·10	·02	·01	·00	—	—	—	—	—
− *·80*	1·98	·56	·14	·03	·01	·00	—	—	—	—
− *·75*	7·05	2·12	·58	·14	·03	·01	—	—	—	—
− *·70*	19·10	6·17	1·81	·47	·10	·02	·00	—	—	—
− *·65*	42·84	14·88	4·64	1·27	·29	·05	·01	—	—	—
− *·60*	83·54	31·23	10·39	3·02	·74	·14	·02	—	—	—
− *·55*	146·13	58·78	20·89	6·43	1·66	·34	·05	·00	—	—
− *·50*	234·22	101·41	38·54	12·61	3·43	·74	·11	·01	—	—
− *·45*	349·12	162·78	66·18	23·04	6·64	1·50	·24	·02	—	—
− *·40*	489·26	245·73	106·99	39·68	12·14	2·90	·49	·05	—	—
− *·35*	649·87	351·73	164·17	64·96	21·11	5·33	·95	·10	·00	—
− *·30*	823·17	480·28	240·55	101·72	35·19	9·43	1·78	·20	·01	—
− *·25*	998·93	628·51	338·14	153·03	56·47	16·10	3·22	·37	·02	—
− *·20*	1165·43	791·03	457·61	222·01	87·57	26·61	5·66	·70	·03	—
− *·15*	1310·64	960·04	597·82	311·43	131·60	42·74	9·69	1·28	·06	—
− *·10*	1423·48	1125·69	755·35	423·25	192·06	66·87	16·23	2·28	·12	—
− *·05*	1495·05	1276·87	924·29	558·10	272·60	102·06	26·61	4·01	·23	—
·00	1519·58	1402·18	1096·21	714·59	376·67	152·13	42·77	6·95	·43	·00
+ *·05*	1495·05	1491·07	1260·42	888·75	506·94	221·67	67·49	11·89	·79	·01
+ *·10*	1423·48	1535·05	1404·71	1073·56	664·54	315·72	104·60	20·08	1·46	·01
+ *·15*	1310·64	1528·81	1516·33	1258·69	848·09	439·58	159·26	33·51	2·68	·02
+ *·20*	1165·43	1471·07	1583·40	1430·69	1052·66	597·82	238·16	55·31	4·91	·04
+ *·25*	998·93	1365·00	1596·49	1573·74	1268·71	793·12	349·55	90·30	8·97	·09
+ *·30*	823·17	1218·19	1550·21	1671·08	1481·38	1024·51	502·86	145·74	16·37	·18
+ *·35*	649·87	1041·98	1444·64	1707·15	1670·43	1284·98	707·60	232·31	29·89	·39
+ *·40*	489·26	850·26	1286·11	1670·36	1811·36	1558·97	970·98	365·12	54·60	·84
+ *·45*	349·12	657·90	1087·22	1556·06	1878·12	1820·03	1293·78	564·21	99·74	1·86
+ *·50*	234·22	478·81	865·73	1369·26	1847·84	2030·22	1663·80	853·62	182·02	4·22
+ *·55*	146·13	324·22	642·35	1125·98	1707·27	2142·80	2047·42	1256·38	331·00	9·90
+ *·60*	83·54	201·23	437·52	852·59	1460·03	2110·68	2381·31	1781·59	596·99	24·05
+ *·65*	42·84	112·08	267·85	582·09	1132·06	1902·13	2570·49	2397·95	1058·86	60·84
+ *·70*	19·10	54·30	142·84	347·36	771·78	1522·30	2504·51	2991·52	1818·97	160·72
+ *·75*	7·05	21·79	63·21	172·59	440·91	1032·18	2106·17	3324·73	2942·45	442·92
+ *·80*	1·98	6·67	21·38	65·80	194·61	547·33	1415·08	3067·10	4243·31	1257·03
+ *·85*	·37	1·34	4·74	16·51	56·94	195·02	654·85	2042·00	4852·41	3500·67
+ *·90*	·03	·12	·49	1·93	7·82	33·12	148·67	706·81	3278·45	8051·44
+ *·95*	·00	·00	·01	·03	·17	·89	5·53	43·15	467·87	6952·68
+ *1·00*	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
Mean	·0000	·0970	·1941	·2915	·3895	·4881	·5876	·6883	·7903	·8941
Mode	·0000	·1190	·2364	·3507	·4608	·5656	·6646	·7575	·8442	·9250
σ	·2500	·2479	·2415	·2307	·2153	·1951	·1696	·1384	·1006	·0551
$(1-\rho^2)/\sqrt{n-1}$	·2500	·2475	·2400	·2275	·2100	·1875	·1600	·1275	·0900	·0475
β_1	·0000	·0168	·0683	·1582	·2934	·4855	·7543	1·1348	1·6940	2·5832
β_2	2·6667	2·6960	2·7861	2·9446	3·1855	3·5340	4·0337	4·7661	5·9012	7·8748

TABLE A. *Ordinates and Constants of Frequency Curves.*

$n = 18$. ρ variate (correlation in population sampled).

r variate (correlation in sample).	*0*	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*	*·7*	*·8*	*·9*
− 1·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
− ·95	·00	—	—	—	—	—	—	—	—	—
− ·90	·01	·00	·00	—	—	—	—	—	—	—
− ·85	·20	·05	·01	·00	—	—	—	—	—	—
− ·80	1·23	·32	·08	·02	·00	—	—	—	—	—
− ·75	4·82	1·34	·34	·08	·01	·00	—	—	—	—
− ·70	14·10	4·24	1·15	·27	·05	·01	—	—	—	—
− ·65	33·66	10·93	3·16	·80	·17	·03	—	—	—	—
− ·60	69·10	24·24	7·52	2·02	·45	·08	·01	—	—	—
− ·55	126·18	47·87	15·93	4·55	1·08	·20	·03	—	—	—
− ·50	209·71	86·05	30·73	9·36	2·35	·46	·06	—	—	—
− ·45	322·33	143·10	54·93	17·88	4·76	·98	·14	·01	—	—
− ·40	463·60	222·77	91·98	32·03	9·09	1·98	·30	·03	—	—
− ·35	629·39	327·48	145·60	54·32	16·44	3·80	·61	·06	—	—
− ·30	811·85	457·58	219·30	87·80	28·40	7·01	1·19	·11	—	—
− ·25	999·97	610·75	315·87	135·94	47·10	12·40	2·24	·23	·01	—
− ·20	1180·56	781·66	436·73	202·39	75·28	21·22	4·09	·44	·02	—
− ·15	1339·70	961·98	581·30	290·60	116·32	35·20	7·27	·84	·03	—
− ·10	1464·32	1140·77	746·40	403·25	174·11	56·74	12·60	1·57	·07	—
− ·05	1543·76	1305·33	925·87	541·62	252·92	89·04	21·34	2·86	·14	—
·00	1571·04	1442·41	1110·44	704·76	356·91	136·21	35·38	5·13	·27	—
+ ·05	1543·76	1539·62	1288·06	888·76	439·54	203·29	57·47	9·09	·51	·00
+ ·10	1464·32	1587·04	1444·69	1086·05	652·63	296·06	91·57	15·86	·98	·01
+ ·15	1339·70	1578·54	1565·59	1285·14	845·22	420·66	143·10	27·33	1·87	·01
+ ·20	1180·56	1512·94	1637·00	1470·71	1062·25	582·69	219·31	46·52	3·55	·02
+ ·25	999·97	1394·42	1648·23	1624·60	1293·27	785·76	329·31	78·24	6·73	·05
+ ·30	811·85	1232·37	1593·57	1727·60	1521·54	1029·39	483·81	129·92	12·75	·11
+ ·35	629·39	1040·48	1473·96	1762·12	1723·97	1306·25	693·90	212·79	24·12	·24
+ ·40	463·60	835·02	1297·82	1715·64	1872·57	1598·97	968·37	343·11	45·64	·54
+ ·45	322·33	632·84	1080·74	1584·29	1937·95	1877·54	1308·88	543·00	86·32	1·26
+ ·50	209·71	449·00	843·82	1375·79	1895·25	2098·72	1702·25	839·57	162·94	3·00
+ ·55	126·18	294·75	610·56	1110·63	1731·96	2209·80	2110·51	1259·46	306·15	7·37
+ ·60	69·10	176·17	402·90	820·29	1456·10	2159·46	2461·52	1813·97	569·59	18·84
+ ·65	33·66	93·71	236·98	541·90	1101·45	1917·07	2648·10	2468·15	1039·63	50·19
+ ·70	14·10	42·89	120·15	309·66	725·26	1497·24	2550·03	3092·09	1830·85	139·75
+ ·75	4·82	16·03	49·82	145·26	394·72	977·87	2094·49	3417·34	3017·33	406·10
+ ·80	1·23	4·48	15·47	51·23	162·68	489·96	1350·14	3087·13	4385·61	1213·45
+ ·85	·20	·79	3·05	11·51	43·06	159·94	582·14	1960·44	4953·44	3534·99
+ ·90	·01	·05	·26	1·14	5·05	23·50	116·49	614·60	3164·79	8320·69
+ ·95	·00	·00	·00	·01	·08	·47	3·32	29·69	377·45	6744·32
+ 1·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
Mean	·0000	·0971	·1944	·2920	·3901	·4888	·5884	·6890	·7909	·8945
Mode	·0000	·1176	·2338	·3472	·4567	·5613	·6605	·7540	·8417	·9236
σ	·2425	·2405	·2342	·2237	·2086	·1889	·1641	·1337	·0970	·0530
$(1-\rho^2)/\sqrt{n-1}$	·2425	·2401	·2328	·2207	·2037	·1819	·1552	·1237	·0873	·0461
β_1	·0000	·0161	·0653	·1511	·2797	·4617	·7147	1·0695	1·5839	2·3830
β_2	2·6842	2·7124	2·7992	2·9515	3·1823	3·5144	3·9873	4·6737	5·7207	7·4908

TABLE A—(*continued*).

$n = 19$. ρ variate (correlation in population sampled).

r variate (correlation in sample).

	0	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*	*·7*	*·8*	*·9*
− 1·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
− ·95	·00	—	—	—	—	—	—	—	—	—
− ·90	·01	·00	—	—	—	—	—	—	—	—
− ·85	·11	·02	·00	·00	—	—	—	—	—	—
− ·80	·76	·18	·04	·01	·00	—	—	—	—	—
− ·75	3·29	·85	·20	·04	·01	—	—	—	—	—
− ·70	10·39	2·90	·73	·16	·03	·00	—	—	—	—
− ·65	26·39	8·00	2·15	·50	·10	·01	—	—	—	—
− ·60	57·03	18·78	5·43	1·35	·27	·04	·00	—	—	—
− ·55	108·73	38·90	12·11	3·21	·70	·12	·01	—	—	—
− ·50	187·37	72·86	24·46	6·94	1·60	·28	·03	·00	—	—
− ·45	296·98	125·54	45·49	13·84	3·41	·64	·08	·01	—	—
− ·40	438·38	201·54	78·91	25·79	6·79	1·35	·18	·01	—	—
− ·35	608·28	304·27	128·86	45·32	12·77	2·71	·39	·03	—	—
− ·30	799·03	435·05	199·51	75·63	22·88	5·19	·79	·07	—	—
− ·25	998·93	592·25	294·45	120·51	39·21	9·54	1·56	·14	·00	—
− ·20	1193·40	770·79	415·93	184·13	64·59	16·89	2·96	·28	·01	—
− ·15	1366·56	961·93	564·06	270·60	102·59	28·93	5·45	·56	·02	—
− ·10	1503·20	1153·66	736·02	383·39	157·51	48·04	9·76	1·07	·04	—
− ·05	1590·74	1331·66	925·52	524·53	234·18	77·52	17·08	2·03	·08	—
·00	1620·88	1480·70	1122·52	693·62	337·49	121·70	29·20	3·78	·16	—
+ *·05*	1590·74	1586·45	1313·57	886·92	471·76	186·07	48·84	6·93	·33	—
+ *·10*	1503·20	1637·37	1482·73	1096·42	639·60	277·05	80·00	12·50	·66	·00
+ *·15*	1366·56	1626·51	1613·08	1309·42	840·60	401·73	128·32	22·24	1·30	·01
+ *·20*	1193·40	1552·77	1688·90	1508·71	1069·70	566·77	201·53	39·05	2·57	·01
+ *·25*	998·93	1421·51	1698·12	1673·64	1315·58	776·85	309·60	67·65	5·04	·03
+ *·30*	799·03	1244·13	1634·75	1782·33	1559·56	1032·16	464·51	115·58	9·90	·06
+ *·35*	608·28	1036·82	1500·76	1815·10	1775·54	1325·12	679·05	194·50	19·43	·15
+ *·40*	438·38	818·35	1306·92	1758·51	1931·83	1636·61	963·78	321·76	38·08	·35
+ *·45*	296·98	607·48	1072·08	1609·70	1995·55	1932·88	1321·43	521·51	74·55	·85
+ *·50*	187·37	420·16	820·76	1379·49	1939·87	2165·06	1738·01	824·05	145·56	2·12
+ *·55*	108·73	267·40	579·15	1093·22	1753·38	2274·19	2171·08	1259·96	282·59	5·48
+ *·60*	57·03	153·91	370·23	787·57	1449·19	2204·82	2539·21	1843·14	542·34	14·73
+ *·65*	26·39	78·18	209·24	503·43	1069·45	1928·16	2722·44	2535·20	1018·65	41·32
+ *·70*	10·39	33·81	100·85	275·47	680·14	1469·57	2591·04	3189·48	1839·04	121·27
+ *·75*	3·29	11·76	39·19	122·01	352·63	924·51	2078·60	3505·34	3087·80	371·57
+ *·80*	·76	3·00	11·17	39·80	135·72	437·70	1285·55	3100·93	4523·43	1169·00
+ *·85*	·11	·47	1·96	8·01	32·49	130·90	516·43	1878·29	5046·26	3562·39
+ *·90*	·01	·02	·14	·67	3·25	16·63	91·09	533·33	3048·86	8581·50
+ *·95*	·00	·00	·00	·01	·04	·25	1·99	20·38	303·89	6528·96
+ *1·00*	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
Mean	·0000	·0973	·1947	·2924	·3906	·4894	·5890	·6896	·7915	·8948
Mode	·0000	·1165	·2316	·3442	·4531	·5576	·6569	·7509	·8394	·9224
σ	·2357	·2337	·2275	·2172	·2025	·1832	·1590	·1294	·0937	·0511
$(1-\rho^2)/\sqrt{n-1}$	·2357	·2333	·2263	·2145	·1980	·1768	·1508	·1202	·0849	·0448
β_1	·0000	·0154	·0626	·1446	·2672	·4400	·6789	1·0110	1·4866	2·2105
β_2	2·7000	2·7272	2·8109	2·9573	3·1787	3·4958	3·9447	4·5897	5·5597	7·1586

TABLE A. *Ordinates and Constants of Frequency Curves.*

$n = 20$. ρ variate (correlation in population sampled).

r variate (correlation in sample).	*0*	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*	*·7*	*·8*	*·9*
− 1·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
− ·95	—	—	—	—	—	—	—	—	—	—
− ·90	·00	·00	—	—	—	—	—	—	—	—
− ·85	·06	·01	·00	—	—	—	—	—	—	—
− ·80	·47	·10	·02	·00	—	—	—	—	—	—
− ·75	2·24	·53	·11	·02	·00	—	—	—	—	—
− ·70	7·64	1·99	·46	·10	·02	·00	—	—	—	—
− ·65	20·65	5·85	1·46	·31	·05	·01	—	—	—	—
− ·60	46·98	14·53	3·91	·90	·17	·02	·00	—	—	—
− ·55	93·51	31·56	9·20	2·26	·45	·07	·01	—	—	—
− ·50	167·11	61·57	19·43	5·14	1·09	·17	·02	—	—	—
− ·45	273·13	109·93	37·61	10·70	2·44	·42	·05	·00	—	—
− ·40	413·76	181·99	67·57	20·74	5·06	·92	·11	·01	—	—
− ·35	586·81	282·18	113·83	37·75	9·91	1·93	·25	·02	—	—
− ·30	784·96	412·86	181·17	65·03	18·39	3·84	·53	·04	—	—
− ·25	996·07	573·27	273·98	106·64	32·57	7·32	1·08	·08	—	—
− ·20	1204·17	758·68	395·39	167·20	55·31	13·42	2·13	·18	·00	—
− ·15	1391·40	960·11	546·33	251·51	90·32	23·73	4·07	·37	·01	—
− ·10	1540·28	1164·55	724·46	363·84	142·24	40·60	7·55	·73	·02	—
− ·05	1636·14	1356·03	923·47	507·05	216·43	67·37	13·64	1·44	·05	—
·00	1669·24	1517·23	1132·65	681·41	318·54	108·54	24·06	2·78	·10	—
+ ·05	1636·14	1631·71	1337·14	883·46	453·78	169·98	41·43	5·27	·21	—
+ ·10	1540·28	1686·21	1518·98	1104·85	625·68	258·79	69·76	9·84	·44	—
+ ·15	1391·40	1672·86	1658·98	1331·72	834·48	382·94	114·86	18·07	·90	·00
+ ·20	1204·17	1590·74	1739·26	1544·87	1075·23	550·27	184·86	32·72	1·85	·01
+ ·25	996·07	1446·47	1746·32	1720·99	1335·82	766·63	290·54	58·39	3·77	·02
+ ·30	784·96	1253·70	1673·93	1835·44	1595·60	1033·05	445·18	102·63	7·68	·04
+ ·35	586·81	1031·28	1525·25	1866·25	1825·32	1341·82	663·32	177·47	15·62	·09
+ ·40	413·76	800·54	1313·68	1799·15	1989·34	1672·08	957·45	301·19	31·71	·22
+ ·45	273·13	582·06	1061·54	1632·51	2051·11	1986·22	1331·67	499·96	64·26	·57
+ ·50	167·11	392·47	796·88	1380·68	1981·92	2229·43	1771·29	807·35	129·80	1·50
+ ·55	93·51	242·15	548·35	1074·11	1771·83	2336·21	2229·32	1258·17	260·36	4·07
+ ·60	46·98	134·22	339·60	754·79	1439·68	2247·04	2614·58	1869·39	515·46	11·50
+ ·65	20·65	65·11	184·41	466·85	1036·50	1935·78	2793·79	2599·35	996·30	33·96
+ ·70	7·64	26·60	84·50	244·62	636·66	1439·79	2627·94	3283·99	1843·93	105·05
+ ·75	2·24	8·62	30·77	102·29	314·46	872·48	2059·10	3589·11	3154·22	339·37
+ ·80	·47	2·00	8·05	30·87	113·01	390·31	1221·83	3109·18	4657·18	1124·15
+ ·85	·06	·28	1·25	5·56	24·47	106·93	457·32	1796·33	5131·57	3583·56
+ ·90	·00	·00	·08	·39	2·09	11·76	71·10	461·97	2931·90	8834·61
+ ·95	—	—	·00	·00	·02	·13	1·19	13·97	244·23	6309·15
+ 1·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
Mean	·0000	·0974	·1950	·2928	·3911	·4900	·5896	·6902	·7919	·8951
Mode	·0000	·1154	·2297	·3415	·4500	·5543	·6538	·7482	·8374	·9213
σ	·2294	·2274	·2214	·2113	·1969	·1780	·1543	·1254	·0907	·0493
$(1-\rho^2)/\sqrt{n-1}$	·2294	·2271	·2202	·2088	·1927	·1721	·1468	·1170	·0826	·0436
β_1	·0000	·0148	·0600	·1386	·2557	·4202	·6464	·9584	1·4001	2·0603
β_2	2·7143	2·7406	2·8213	2·9623	3·1749	3·4783	3·9055	4·5131	5·4154	6·8681

TABLE A—(*continued*).

$n = 21$. ρ variate (correlation in population sampled).

r variate (correlation in sample).	*0*	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*	*·7*	*·8*	*·9*
− 1·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
− ·95	·00	—	—	—	—	—	—	—	—	—
− ·90	·00	·00	—	—	—	—	—	—	—	—
− ·85	·03	·01	·00	—	—	—	—	—	—	—
− ·80	·29	·06	·01	·00	—	—	—	—	—	—
− ·75	1·52	·34	·07	·01	·00	—	—	—	—	—
− ·70	5·61	1·36	·29	·05	·01	—	—	—	—	—
− ·65	16·13	4·27	·99	·19	·03	·00	—	—	—	—
− ·60	38·65	11·22	2·82	·60	·10	·01	—	—	—	—
− ·55	80·30	25·56	6·97	1·59	·29	·04	·00	—	—	—
− ·50	148·80	51·95	15·41	3·79	·74	·11	·01	—	—	—
− ·45	250·78	96·10	31·04	8·26	1·74	·27	·03	—	—	—
− ·40	389·90	164·07	57·77	16·64	3·77	·63	·07	·00	—	—
− ·35	565·17	261·27	100·39	31·39	7·67	1·37	·16	·01	—	—
− ·30	769·89	391·17	164·25	55·82	14·76	2·84	·35	·02	—	—
− ·25	991·59	553·98	254·51	94·20	27·02	5·61	·75	·05	—	—
− ·20	1213·06	745·68	375·26	151·59	47·28	10·64	1·53	·11	·00	—
− ·15	1414·38	956·73	528·29	233·39	79·38	19·43	3·04	·24	·01	—
− ·10	1575·70	1173·63	711·91	344·73	128·23	34·26	5·83	·50	·01	—
− ·05	1680·10	1378·59	919·93	489·35	199·70	58·45	10·88	1·02	·03	—
·00	1716·23	1552·13	1141·00	668·33	300·17	96·65	19·79	2·04	·06	—
+ ·05	1680·10	1675·52	1358·90	878·59	435·79	155·05	35·09	4·01	·14	—
+ ·10	1575·70	1733·68	1553·58	1111·53	611·07	241·33	60·74	7·73	·29	—
+ ·15	1414·38	1717·73	1703·39	1352·20	827·05	364·44	102·64	14·66	·63	—
+ ·20	1213·06	1626·97	1788·20	1579·31	1079·03	533·39	169·29	27·37	1·33	·00
+ ·25	991·59	1469·48	1792·97	1766·81	1354·17	755·33	272·20	50·31	2·82	·01
+ ·30	769·89	1261·29	1711·25	1887·05	1629·83	1032·26	425·95	90·99	5·95	·02
+ ·35	565·17	1024·10	1547·62	1915·72	1873·44	1356·52	646·90	161·66	12·53	·06
+ ·40	389·90	781·85	1318·32	1837·75	2045·23	1705·56	949·63	281·48	26·36	·14
+ ·45	250·78	556·80	1049·40	1652·96	2104·80	2037·72	1339·82	478·52	55·31	·38
+ ·50	148·80	366·00	772·43	1379·62	2021·59	2291·99	1802·29	789·71	115·56	1·06
+ ·55	80·30	218·92	518·34	1053·63	1787·57	2396·03	2285·43	1254·35	239·50	3·02
+ ·60	38·65	116·85	311·00	722·19	1427·92	2286·37	2687·85	1892·96	489·12	8·96
+ ·65	16·13	54·13	162·26	432·22	1002·93	1940·29	2862·39	2660·83	972·87	27·86
+ ·70	5·61	20·90	70·68	216·87	595·00	1408·33	2661·07	3375·86	1845·86	90·85
+ ·75	1·52	6·31	24·12	85·61	279·97	822·04	2036·49	3668·97	3216·90	309·47
+ ·80	·29	1·34	5·79	23·90	93·95	347·48	1159·40	3112·44	4787·20	1079·30
+ ·85	·03	·16	·80	3·86	18·41	87·22	404·32	1715·20	5209·97	3599·09
+ ·90	·00	·00	·04	·23	1·34	8·29	55·40	399·51	2814·91	9080·68
+ ·95	—	—	·00	·00	·01	·07	·71	9·56	195·96	6087·03
+ 1·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
Mean	·0000	·0976	·1952	·2932	·3916	·4905	·5902	·6907	·7924	·8954
Mode	·0000	·1145	·2279	·3391	·4472	·5515	·6509	·7457	·8354	·9203
σ	·2236	·2216	·2157	·2058	·1917	·1732	·1500	·1218	·0880	·0478
$(1-\rho^2)/\sqrt{n-1}$	·2236	·2214	·2147	·2035	·1878	·1677	·1431	·1140	·0805	·0425
β_1	·0000	·0142	·0577	·1331	·2451	·4020	·6166	·9107	1·3227	1·9288
β_2	2·7273	2·7527	2·8306	2·9666	3·1711	3·4617	3·8683	4·4432	5·2858	6·6169

TABLE A. *Ordinates and Constants of Frequency Curves.*

$n = 22$. ρ variate (correlation in population sampled).

r variate (correlation in sample).	*0*	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*	*·7*	*·8*	*·9*
− 1·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
− ·95	·00	—	—	—	—	—	—	—	—	—
− ·90	·01	—	—	—	—	—	—	—	—	—
− ·85	·02	·00	·00	—	—	—	—	—	—	—
− ·80	·18	·03	·01	·00	—	—	—	—	—	—
− ·75	1·03	·21	·04	·01	—	—	—	—	—	—
− ·70	4·11	·92	·18	·03	·00	—	—	—	—	—
− ·65	12·59	3·11	·67	·12	·02	·00	—	—	—	—
− ·60	31·74	8·65	2·02	·40	·06	·01	—	—	—	—
− ·55	68·85	20·67	5·28	1·12	·19	·02	·00	—	—	—
− ·50	132·30	43·77	12·21	2·80	·50	·07	·01	—	—	—
− ·45	229·92	83·90	25·58	6·36	1·24	·17	·02	—	—	—
− ·40	366·87	147·70	49·31	13·34	2·80	·43	·04	·00	—	—
− ·35	543·53	241·56	88·41	26·06	5·93	·97	·10	·01	—	—
− ·30	754·00	370·08	148·69	47·84	11·83	2·09	·23	·01	—	—
− ·25	985·69	534·57	236·09	83·10	22·38	4·29	·52	·03	—	—
− ·20	1220·22	731·56	355·63	137·23	40·36	8·43	1·10	·07	—	—
− ·15	1435·65	951·98	510·10	216·26	69·67	15·89	2·26	·16	·00	—
− ·10	1609·59	1181·06	698·57	326·14	115·44	28·86	4·49	·34	·01	—
− ·05	1722·72	1399·48	915·06	471·58	183·99	50·64	8·67	·72	·02	—
·00	1761·97	1585·51	1147·75	654·54	282·44	85·93	16·25	1·50	·04	—
+ *·05*	1722·72	1718·00	1379·01	872·46	417·89	141·20	29·67	3·04	·09	—
+ *·10*	1609·59	1779·88	1586·65	1116·63	595·93	224·73	52·80	6·06	·20	—
+ *·15*	1435·65	1761·23	1746·45	1370·99	818·50	346·33	91·59	11·87	·43	—
+ *·20*	1220·22	1661·60	1835·83	1612·18	1081·27	516·27	154·80	22·86	·96	—
+ *·25*	985·69	1490·67	1838·17	1811·21	1370·78	743·10	254·65	43·29	2·10	·00
+ *·30*	754·00	1267·07	1746·86	1937·29	1662·37	1029·97	406·96	80·55	4·60	·01
+ *·35*	543·53	1015·49	1568·03	1963·65	1920·03	1369·38	629·96	147·04	10·04	·03
+ *·40*	366·87	762·48	1321·06	1874·43	2099·64	1737·17	940·51	262·68	21·88	·09
+ *·45*	229·92	531·86	1035·89	1671·23	2156·76	2087·52	1346·06	457·35	47·54	·26
+ *·50*	132·30	340·82	747·64	1376·56	2059·06	2352·90	1831·17	771·34	102·73	·75
+ *·55*	68·85	197·63	489·26	1032·04	1800·84	2453·82	2339·55	1248·74	219·99	2·23
+ *·60*	31·74	101·58	284·38	690·00	1414·20	2323·01	2759·17	1914·05	463·46	6·97
+ *·65*	12·59	44·94	142·57	399·58	969·04	1942·00	2928·43	2719·83	948·62	22·83
+ *·70*	4·11	16·39	59·04	191·99	555·25	1375·57	2690·72	3465·29	1845·14	78·45
+ *·75*	1·03	4·60	18·88	71·56	248·90	773·40	2011·22	3745·20	3276·10	281·79
+ *·80*	·18	·89	4·16	18·48	78·00	308·91	1098·57	3111·21	4913·78	1034·74
+ *·85*	·02	·10	·51	2·67	13·82	71·03	356·95	1635·37	5281·97	3609·52
+ *·90*	·01	·00	·02	·13	·86	5·84	43·11	345·00	2698·71	9320·25
+ *·95*	·00	—	·00	·00	·00	·04	·42	6·53	157·01	5864·34
+ *1·00*	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
Mean	·0000	·0977	·1955	·2935	·3920	·4910	·5906	·6912	·7928	·8956
Mode	·0000	·1137	·2264	·3369	·4447	·5486	·6484	·7435	·8339	·9194
σ	·2182	·2162	·2105	·2007	·1869	·1688	·1461	·1185	·0855	·0464
$(1-\rho^2)/\sqrt{n-1}$	·2182	·2160	·2095	·1986	·1833	·1637	·1396	·1113	·0786	·0415
β_1	·0000	·0137	·0555	·1279	·2354	·3853	·5893	·8674	1·2532	1·8125
β_2	2·7391	2·7630	2·8390	2·9703	3·1672	3·4461	3·8328	4·3790	5·1687	6·3926

TABLE A—(*continued*).

$n = 23$. ρ variate (correlation in population sampled).

r variate (correlation in sample).	*0*	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*	*·7*	*·8*	*·9*
− 1·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
− ·95	·00	—	—	—	—	—	—	—	—	—
− ·90	·00	—	—	—	—	—	—	—	—	—
− ·85	·01	·00	—	—	—	—	—	—	—	—
− ·80	·11	·02	—	—	—	—	—	—	—	—
− ·75	·70	·13	·00	—	—	—	—	—	—	—
− ·70	3·01	·63	·11	·00	·00	—	—	—	—	—
− ·65	9·81	2·26	·45	·08	·01	—	—	—	—	—
− ·60	26·04	6·66	1·45	·26	·04	·00	—	—	—	—
− ·55	58·96	16·69	3·99	·78	·12	·01	—	—	—	—
− ·50	117·47	36·83	9·65	2·06	·34	·04	·00	—	—	—
− ·45	210·52	73·14	21·06	4·90	·88	·11	·01	—	—	—
− ·40	344·75	132·79	42·04	10·68	2·08	·29	·02	—	—	—
− ·35	522·03	223·04	77·76	21·61	4·58	·69	·06	·00	—	—
− ·30	737·47	349·67	134·43	40·95	9·47	1·54	·15	·01	—	—
− ·25	978·54	515·16	218·71	73·21	18·51	3·28	·36	·02	—	—
− ·20	1225·82	716·90	336·58	124·07	34·41	6·67	·79	·04	—	—
− ·15	1455·33	946·00	491·89	200·13	61·07	12·98	1·68	·10	—	—
− ·10	1642·05	1186·97	684·57	308·15	103·79	24·29	3·46	·23	·00	—
− ·05	1764·10	1418·82	909·02	453·86	169·29	43·81	6·89	·51	·01	—
·00	1806·56	1617·48	1153·02	640·19	265·41	76·30	13·33	1·10	·02	—
+ ·05	1764·10	1759·25	1397·58	865·25	400·21	128·44	25·06	2·30	·06	—
+ ·10	1642·05	1824·91	1618·30	1120·27	580·40	208·99	45·84	4·75	·13	—
+ ·15	1455·33	1803·46	1788·25	1388·22	808·98	328·68	81·62	9·60	·30	—
+ ·20	1225·82	1694·75	1882·27	1643·56	1082·09	499·05	141·37	19·07	·69	—
+ ·25	978·54	1510·18	1882·05	1854·28	1385·76	730·12	237·92	37·20	1·56	·00
+ ·30	737·47	1271·20	1780·86	1986·26	1693·34	1026·34	388·31	71·21	3·55	·01
+ ·35	522·03	1005·63	1586·63	2010·13	1965·21	1380·56	612·67	133·58	8·04	·02
+ ·40	344·75	742·61	1322·06	1909·35	2152·67	1767·06	930·25	244·82	18·14	·06
+ ·45	210·52	507·37	1021·21	1687·50	2207·11	2135·75	1350·57	436·53	40·80	·17
+ ·50	117·47	316·95	722·70	1371·71	2094·49	2412·26	1858·09	752·42	91·21	·52
+ ·55	58·96	178·18	461·21	1009·57	1811·83	2509·73	2391·84	1241·53	201·81	1·65
+ ·60	26·04	88·20	259·71	658·38	1398·78	2357·16	2828·70	1932·86	438·57	5·42
+ ·65	9·81	37·26	125·10	368·92	935·07	1941·17	2992·09	2776·53	923·77	18·68
+ ·70	3·01	12·84	49·25	169·74	517·49	1341·82	2717·16	3552·48	1842·02	67·66
+ ·75	·70	3·36	14·76	59·73	220·99	726·69	1983·68	3818·06	3332·08	256·26
+ ·80	·11	·59	2·99	14·27	64·66	274·26	1039·58	3105·96	5037·18	990·75
+ ·85	·01	·06	·33	1·85	10·37	57·78	314·71	1557·24	5348·05	3615·31
+ ·90	·00	·00	·01	·08	·55	4·11	33·50	297·55	2583·97	9553·82
+ ·95	·00	·00	·00	·00	·00	·02	·25	4·46	125·64	5642·53
+ 1·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
Mean	·0000	·0978	·1957	·2938	·3923	·4914	·5911	·6916	·7931	·8958
Mode	·0000	·1130	·2250	·3351	·4424	·5462	·6461	·7415	·8324	·9185
σ	·2132	·2113	·2056	·1960	·1825	·1647	·1425	·1155	·0832	·0450
$(1-\rho^2)/\sqrt{n-1}$	·2132	·2111	·2047	·1940	·1791	·1599	·1364	·1087	·0768	·0405
β_1	·0000	·0132	·0535	·1232	·2264	·3698	·5645	·8279	1·1905	1·7092
β_2	2·7500	2·7738	2·8467	2·9735	3·1633	3·4313	3·8024	4·3197	5·0623	6·1951

TABLE A. *Ordinates and Constants of Frequency Curves.*

$n = 24$. ρ variate (correlation in population sampled).

r variate (correlation in sample).

	0	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*	*·7*	*·8*	*·9*
− *1·00*	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
− *·95*	—	—	—	—	—	—	—	—	—	—
− *·90*	·00	—	—	—	—	—	—	—	—	—
− *·85*	·01	—	—	—	—	—	—	—	—	—
− *·80*	·07	·00	·00	—	—	—	—	—	—	—
− *·75*	·48	·08	·01	—	—	—	—	—	—	—
− *·70*	2·20	·43	·07	·00	—	—	—	—	—	—
− *·65*	7·63	1·65	·30	·05	·00	—	—	—	—	—
− *·60*	21·33	5·12	1·04	·17	·02	·00	—	—	—	—
− *·55*	50·42	13·46	3·01	·55	·08	·01	—	—	—	—
− *·50*	104·18	30·95	7·63	1·52	·23	·03	·00	—	—	—
− *·45*	192·53	63·69	17·31	3·76	·63	·08	·01	—	—	—
− *·40*	323·58	119·24	35·80	8·54	1·54	·20	·02	—	—	—
− *·35*	500·79	205·69	68·31	17·90	3·53	·49	·04	—	—	—
− *·30*	720·45	329·99	121·39	35·02	7·57	1·13	·10	·00	—	—
− *·25*	970·29	495·86	202·37	64·42	15·29	2·51	·25	·01	—	—
− *·20*	1229·99	701·70	318·18	112·03	29·30	5·27	·57	·03	—	—
− *·15*	1473·52	938·94	473·77	184·97	53·46	10·58	1·25	·07	—	—
− *·10*	1673·17	1191·49	670·05	290·81	93·20	20·41	2·66	·16	·00	—
− *·05*	1804·33	1436·72	901·95	436·29	155·59	37·86	5·48	·36	·01	—
·00	1850·07	1648·13	1156·93	625·41	249·11	67·67	10·92	·80	·01	—
+ *·05*	1804·33	1799·35	1414·71	857·07	382·82	116·68	21·14	1·74	·04	—
+ *·10*	1673·17	1868·86	1648·62	1122·60	564·61	194·13	39·75	3·71	·09	—
+ *·15*	1473·52	1844·51	1828·88	1403·99	798·61	311·57	72·65	7·76	·21	—
+ *·20*	1229·99	1726·50	1927·58	1673·57	1081·63	481·83	128·95	15·89	·49	—
+ *·25*	970·29	1528·14	1924·68	1896·13	1399·26	716·52	222·03	31·93	1·16	—
+ *·30*	720·45	1273·84	1813·38	2034·06	1722·83	1021·51	370·08	62·89	2·74	·00
+ *·35*	500·79	994·68	1603·54	2055·28	2009·07	1390·19	595·15	121·20	6·42	·01
+ *·40*	323·58	722·40	1321·50	1942·61	2204·43	1795·33	919·02	227·90	15·02	·04
+ *·45*	192·53	483·43	1005·54	1701·90	2255·95	2182·51	1353·49	416·18	34·98	·12
+ *·50*	104·18	294·40	697·76	1365·25	2128·00	2470·20	1883·18	733·09	80·88	·37
+ *·55*	50·42	160·45	434·25	986·41	1820·73	2563·87	2442·41	1232·91	184·91	1·22
+ *·60*	21·33	76·48	236·89	627·46	1381·90	2388·99	2896·56	1949·56	414·53	4·21
+ *·65*	7·63	30·86	109·64	340·21	901·23	1938·06	3053·53	2831·08	898·52	15·27
+ *·70*	2·20	10·05	41·03	149·89	481·72	1307·36	2740·64	3637·57	1836·75	58·29
+ *·75*	·48	2·45	11·52	49·80	195·98	682·00	1954·22	3887·76	3385·03	232·77
+ *·80*	·07	·39	2·14	11·00	53·55	243·21	982·60	3097·07	5157·63	947·52
+ *·85*	·01	·03	·21	1·28	7·76	46·94	277·15	1481·10	5408·62	3616·87
+ *·90*	·00	·00	·01	·04	·35	2·89	26·01	256·32	2471·22	9781·81
+ *·95*	·00	·00	·00	·00	·00	·01	·15	3·04	100·42	5422·78
+ *1·00*	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
Mean	·0000	·0979	·1959	·2941	·3927	·4918	·5915	·6920	·7934	·8960
Mode	·0000	·1124	·2238	·3334	·4404	·5441	·6440	·7397	·8310	·9178
σ	·2085	·2067	·2011	·1916	·1783	·1609	·1391	·1127	·0811	·0438
$(1-\rho^2)/\sqrt{n-1}$	·2085	·2064	·2002	·1897	·1752	·1564	·1334	·1063	·0751	·0396
β_1	·0000	·0127	·0516	·1187	·2180	·3557	·5419	·7918	1·1335	1·6167
β_2	2·7600	2·7826	2·8537	2·9764	3·1596	3·4174	3·7774	4·2653	4·9654	6·0161

TABLE A—(*continued*).

$n = 25$. ρ variate (correlation in population sampled).

r variate (correlation in sample).	*0*	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*	*·7*	*·8*	*·9*
– 1·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
– ·95	—	—	—	—	—	—	—	—	—	—
– ·90	—	—	—	—	—	—	—	—	—	—
– ·85	·00	—	—	—	—	—	—	—	—	—
– ·80	·04	·00	—	—	—	—	—	—	—	—
– ·75	·32	·05	·00	—	—	—	—	—	—	—
– ·70	1·61	·29	·05	·00	—	—	—	—	—	—
– ·65	5·93	1·20	·21	·03	·00	—	—	—	—	—
– ·60	17·46	3·93	·75	·12	·01	—	—	—	—	—
– ·55	43·08	10·85	2·27	·38	·05	·00	—	—	—	—
– ·50	92·30	25·99	6·01	1·11	·16	·01	—	—	—	—
– ·45	175·88	55·40	14·22	2·89	·44	·05	·00	—	—	—
– ·40	303·38	106·96	30·45	6·82	1·14	·13	·01	—	—	—
– ·35	479·90	189·49	59·94	14·80	2·72	·34	·03	—	—	—
– ·30	703·06	311·08	109·50	29·91	6·05	·83	·07	·00	—	—
– ·25	961·07	476·77	187·04	56·62	12·62	1·80	·17	·01	—	—
– ·20	1232·83	686·08	300·46	101·06	24·92	4·15	·41	·02	—	—
– ·15	1490·32	930·93	455·82	170·78	46·75	8·62	·93	·04	—	—
– ·10	1703·04	1194·73	655·13	274·14	83·60	17·14	2·04	·11	—	—
– ·05	1843·49	1453·28	893·96	418·94	142·84	32·68	4·35	·25	·00	—
·00	1892·58	1677·56	1159·60	610·31	233·56	59·95	8·94	·59	·01	—
+ ·05	1843·49	1838·37	1430·51	848·05	365·78	105·89	17·81	1·32	·02	—
+ ·10	1703·04	1911·80	1677·69	1123·71	548·65	180·12	34·44	2·90	·06	—
+ ·15	1490·32	1884·46	1868·40	1418·41	787·53	295·02	64·59	6·26	·14	—
+ ·20	1232·83	1756·95	1971·86	1702·29	1080·00	464·70	117·49	13·22	·35	—
+ ·25	961·07	1544·63	1966·16	1936·84	1411·36	702·41	206·98	27·37	·86	—
+ ·30	703·06	1275·10	1844·50	2080·76	1750·96	1015·61	352·32	55·47	2·11	·00
+ ·35	479·90	982·79	1618·89	2099·17	2051·69	1398·37	577·51	109·85	5·13	·01
+ ·40	303·38	701·99	1319·51	1974·33	2255·00	1822·10	906·95	211·92	12·43	·02
+ ·45	175·88	460·12	989·05	1714·58	2303·40	2227·89	1354·96	396·34	29·95	·08
+ ·50	92·30	273·17	672·95	1357·37	2159·72	2526·88	1906·56	713·49	71·65	·26
+ ·55	43·08	144·33	408·43	962·75	1827·71	2616·37	2491·37	1223·04	169·24	·90
+ ·60	17·46	66·25	215·85	597·36	1363·75	2418·65	2962·87	1964·30	391·39	3·26
+ ·65	5·93	25·53	95·99	313·40	867·68	1932·87	3112·90	2883·60	873·02	12·46
+ ·70	1·61	7·85	34·15	132·22	447·95	1272·41	2761·35	3720·72	1829·54	50·16
+ ·75	·32	1·78	8·99	41·47	173·61	639·37	1923·13	3954·50	3435·16	211·20
+ ·80	·04	·26	1·53	8·48	44·30	215·45	927·75	3084·92	5275·33	905·21
+ ·85	·00	·02	·13	·88	5·81	38·09	243·81	1407·18	5464·05	3614·59
+ ·90	—	·00	·00	·00	·22	2·03	20·16	220·57	2360·87	10004·61
+ ·95	—	—	—	—	·00	·01	·09	2·07	80·18	5206·06
+ 1·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
Mean	·0000	·0980	·1960	·2943	·3930	·4921	·5918	·6923	·7937	·8962
Mode	·0000	·1118	·2227	·3318	·4385	·5421	·6420	·7380	·8297	·9170
σ	·2041	·2023	·1968	·1875	·1744	·1573	·1359	·1100	·0791	·0427
$(1-\rho^2)/\sqrt{n-1}$	·2041	·2021	·1960	·1858	·1715	·1531	·1306	·1041	·0735	·0388
β_1	·0000	·0123	·0499	·1146	·2102	·3423	·5203	·7586	1·0816	1·5334
β_2	2·7692	2·7916	2·8601	2·9788	3·1559	3·4042	3·7453	4·2149	4·8769	5·8584

TABLE A. *Ordinates and Constants of Frequency Curves.*

$n = 50$. ρ variate (correlation in population sampled).

r variate (correlation in sample).	*0*	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*	*·7*	*·8*	r variate (correlation in sample).	*·9*
−1·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	*·67*	·2
− ·95	—	—	—	—	—	—	—	—	—	*·68*	·3
− ·90	—	—	—	—	—	—	—	—	—	*·69*	·6
− ·85	—	—	—	—	—	—	—	—	—	*·70*	1·0
− ·80	—	—	—	—	—	—	—	—	—	*·71*	1·7
− ·75	—	—	—	—	—	—	—	—	—	*·72*	2·9
− ·70	·00	—	—	—	—	—	—	—	—	*·73*	5·1
− ·65	·01	—	—	—	—	—	—	—	—	*·74*	8·8
− ·60	·10	·00	—	—	—	—	—	—	—	*·75*	15·3
− ·55	·69	·04	·00	—	—	—	—	—	—	*·76*	26·7
− ·50	3·68	·27	·01	—	—	—	—	—	—	*·77*	46·4
− ·45	15·10	1·40	·08	·00	—	—	—	—	—	*·78*	80·4
− ·40	49·85	5·82	·44	·02	—	—	—	—	—	*·79*	138·9
− ·35	136·13	20·06	1·88	·11	·00	—	—	—	—	*·80*	238·4
− ·30	314·21	58·57	6·85	·48	·02	—	—	—	—	*·81*	406·0
− ·25	623·17	147·07	21·50	1·85	·09	—	—	—	—	*·82*	683·7
− ·20	1075·24	321·70	59·02	6·32	·36	·00	—	—	—	*·83*	1134·8
− ·15	1629·13	618·58	142·88	19·11	1·35	·04	—	—	—	*·84*	1848·2
− ·10	2182·12	1052·79	307·18	51·61	4·55	·18	·00	—	—	*·85*	2936·7
− ·05	2595·77	1593·19	589·27	125·03	13·87	·68	·01	—	—	*·86*	4519·5
·00	2749·60	2149·47	1011·38	272·76	38·38	2·39	·05	—	—	*·87*	6673·8
+ ·05	2595·77	2587·70	1554·59	535·97	96·53	7·70	·20	·00	—	*·88*	9340·1
+ ·10	2182·12	2777·44	2138·36	948·41	220·60	22·82	·78	·01	—	*·89*	12187·5
+ ·15	1629·13	2650·80	2625·45	1507·84	457·26	62·11	2·82	·02	—	*·90*	14502·0
+ ·20	1075·24	2239·38	2864·46	2144·80	856·50	154·86	9·46	·11	—	*·91*	15261·3
+ ·25	623·17	1663·32	2758·76	2712·27	1441·46	351·85	29·47	·48	—	*·92*	13599·9
+ ·30	314·21	1076·19	2323·98	3022·24	2161·66	723·72	84·89	1·99	·00	*·93*	9630·6
+ ·35	136·13	599·07	1691·43	2932·02	2856·13	1333·93	224·22	7·75	·02	*·94*	4918·7
+ ·40	49·85	282·26	1046·45	2437·43	3274·68	2172·97	536·92	28·37	·09	*·95*	1550·4
+ ·45	15·10	110·16	538·66	1700·04	3192·62	3070·40	1147·17	96·36	·51	*·96*	230·3
+ ·50	3·68	34·61	224·22	967·26	2575·61	3668·50	2138·79	298·71	2·85	*·97*	9·6
+ ·55	·69	8·42	72·63	432·21	1656·86	3578·51	3372·39	824·60	15·26	*·98*	·3
+ ·60	·10	1·51	17·37	143·93	807·35	2713·26	4300·25	1954·75	76·77	*·99*	·0
+ ·65	·01	·18	2·84	33·16	276·92	1489·70	4152·55	3764·57	350·56		
+ ·70	·00	·01	·29	4·73	59·97	532·70	2747·94	5398·21	1367·63		
+ ·75	—	·00	·01	·35	6·91	104·96	1061·91	4990·96	4092·05		
+ ·80	—	—	·00	·01	·32	8·58	181·98	2306·06	7650·44		
+ ·85	—	—	—	·00	·00	·17	8·16	322·77	5817·30		
+ ·90	—	—	—	—	—	·00	·03	4·26	621·81		
+ ·95	—	—	—	—	—	—	·00	·00	·24		
+1·00	·00	·00	·00	·00	·00	·00	·00	·00	·00		

For the constants of the curves for $n=50$: see p. 372 above.

TABLE A—(*continued*).

$n = 100$. ρ variate (correlation in population sampled).

r variate (correlation in sample).	*0*	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*	*·7*	*·8*	r variate (correlation in sample).	*·9*	*·9* (normal curve)*
−1·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	*·75*	·1	·0
− ·95	—	—	—	—	—	—	—	—	—	*·76*	·2	—
− ·90	—	—	—	—	—	—	—	—	—	*·77*	·5	—
− ·85	—	—	—	—	—	—	—	—	—	*·78*	1·4	—
− ·80	—	—	—	—	—	—	—	—	—	*·79*	4·0	·0
− ·75	—	—	—	—	—	—	—	—	—	*·80*	11·3	·2
− ·70	—	—	—	—	—	—	—	—	—	*·81*	31·3	·3
− ·65	—	—	—	—	—	—	—	—	—	*·82*	84·7	3·2
− ·60	—	—	—	—	—	—	—	—	—	*·83*	221·8	25·3
− ·55	—	—	—	—	—	—	—	—	—	*·84*	556·2	150·2
− ·50	·00	—	—	—	—	—	—	—	—	*·85*	1320·0	678·6
− ·45	·08	·00	—	—	—	—	—	—	—	*·86*	2919·0	2330·1
− ·40	·91	·01	—	—	—	—	—	—	—	*·87*	5895·9	6082·6
− ·35	7·43	·15	·00	—	—	—	—	—	—	*·88*	10597·3	11944·8
− ·30	42·60	1·41	·02	—	—	—	—	—	—	*·89*	16373·8	18211·3
− ·25	177·84	9·50	·18	·00	—	—	—	—	—	*·90*	20754·4	20887·0
− ·20	555·18	48·00	1·55	·02	—	—	—	—	—	*·91*	20233·5	18211·3
− ·15	1321·36	185·37	9·53	·16	·00	—	—	—	—	*·92*	13848·4	11944·8
− ·10	2431·67	554·86	45·84	1·24	·01	—	—	—	—	*·93*	5823·1	6082·6
− ·05	3493·29	1299·62	173·78	7·57	·09	—	—	—	—	*·94*	1227·8	2330·1
·00	3939·27	2395·29	522·21	36·98	·70	·00	—	—	—	*·95*	93·7	678·6
+ ·05	3493·29	3480·22	1246·23	145·32	4·56	·03	—	—	—	*·96*	1·5	150·2
+ ·10	2431·67	3979·11	2358·16	458·62	24·21	·25	—	—	—	*·97*	—	25·3
+ ·15	1321·36	3560·42	3519·22	1156·81	104·66	1·87	·00	—	—	*·98*	—	3·2
+ ·20	555·18	2469·56	4103·61	2311·65	365·76	11·67	·04	—	—	*·99*	—	·3
+ ·25	177·84	1309·30	3687·36	3611·32	1021·01	59·96	·41	—	—	*1·00*	—	·2
+ ·30	42·60	520·41	2504·77	4329·36	2237·43	249·60	3·35	·00	—			
+ ·35	7·43	151·11	1253·64	3884·32	3759·08	824·50	22·96	·03	—			
+ ·40	·91	30·98	446·88	2522·86	4690·55	2099·42	127·86	·35	—			
+ ·45	·08	4·29	108·49	1135·08	4166·27	3962·12	558·78	3·87	—			
+ ·50	·00	·38	16·90	333·60	2488·44	5254·02	1829·25	35·59	·00			
+ ·55	—	·02	1·56	59·16	925·05	4549·13	4200·10	254·84	·02			
+ ·60	—	·00	·08	5·68	192·25	2320·57	6157·92	1316·29	2·01			
+ ·65	—	—	·00	·25	19·17	601·45	5023·96	4363·45	38·45			
+ ·70	—	—	—	·00	·73	63·47	1850·41	7728·87	519·97			
+ ·75	—	—	—	—	·01	1·92	220·19	5408·23	3951·47			
+ ·80	—	—	—	—	·00	·01	4·76	876·76	10951·32			
+ ·85	—	—	—	—	—	·00	·01	11·56	4488·65			
+ ·90	—	—	—	—	—	—	·00	·00	29·37			
+ ·95	—	—	—	—	—	—	—	—	·00			
+1·00	·00	·00	·00	·00	·00	·00	·00	·00	·00			

* These ordinates indicate how poor is the approximation of a normal curve to the frequency of r, where n is 100, but ρ is large.

For the constants of the curves for $n = 100$: see p. 372 above.

TABLE A. *Ordinates and Constants of Frequency Curves.*

$n = 400$. ρ variate (correlation in population sampled).

r variate (correlation in sample).	*0*	*·1*	*·2*	*·3*	*·4*	*·5*	*·6*
− *·40*	·00	·00	·00	·00	·00	·00	·00
− *·35*	—	—	—	—	—	—	—
− *·30*	—	—	—	—	—	—	—
− *·25*	·00	—	—	—	—	—	—
− *·20*	2·46	·00	—	—	→	—	—
− *·15*	87·84	·03	—	—	—	—	—
− *·10*	1087·30	6·72	·00	—	—	—	—
− *·05*	4845·66	89·41	·03	—	—	—	—
·00	7953·88	1071·03	2·31	·00	—	—	—
+ *·05*	4845·66	4809·08	77·24	·01	—	—	—
+ *·10*	1087·30	8034·24	990·50	1·37	—	—	—
+ *·15*	87·84	4878·55	4767·51	55·10	·00	—	—
+ *·20*	2·46	1037·25	8285·39	846·48	·52	—	—
+ *·25*	·00	72·74	4910·62	4701·88	30·13	·00	—
+ *·30*	—	1·55	917·19	8740·76	642·95	·01	—
+ *·35*	—	·01	48·55	4906·74	4567·01	10·75	·00
+ *·40*	—	·00	·63	724·97	9469·37	399·28	·01
+ *·45*	—	—	·00	23·50	4810·20	4278·49	1·75
+ *·50*	—	—	—	·13	473·26	10606·00	167·53
+ *·55*	—	—	—	·00	6·55	4491·43	3668·41
+ *·60*	—	—	—	--	·08	212·53	12429·40
+ *·65*	—	—	—	—	·00	·16	3688·70
+ *·70*	—	—	—	—	—	·00	40·04
+ *·75*	—	—	—	—	—	—	·00
+ *·80*	—	—	—	—	—	—	—
+ *·85*	—	—	—	—	—	—	—
+ *·90*	—	—	—	—	—	—	—
+ *·95*	—	—	—	—	—	—	—
+*1·00*	·00	·00	·00	·00	·00	·00	·00

r variate (correlation in sample).	*·7*	*·7* normal*	*·8*	*·8* normal*	*·9*	*·9* normal*
·54	·0	·0	·0	·0	·0	·0
·55	·1	—	—	—	—	—
·56	·2	—	—	—	—	—
·57	·8	·0	—	—	—	—
·58	2·8	·2	—	—	—	—
·59	9·3	1·4	—	—	—	—
·60	28·7	7·3	—	—	—	—
·61	82·9	31·3	—	—	—	—
·62	221·2	115·3	—	—	—	—
·63	542·5	364·4	—	—	—	—
·64	1212·0	987·7	—	—	—	—
·65	2478·7	2296·4	—	—	—	—
·66	4553·8	4579·8	—	—	—	—
·67	7487·9	7834·8	—	—	—	—
·68	10922·9	11497·0	·0	—	—	—
·69	13999·7	14471·6	·1	—	—	—
·70	15598·3	15625·2	·2	·0	—	—
·71	14931·6	14471·6	2·2	·1	—	—
·72	12106·9	11497·0	11·2	1·2	—	—
·73	8212·0	7834·8	52·2	11·7	—	—
·74	4572·5	4579·8	213·0	86·8	—	—
·75	2052·1	2296·4	751·2	471·8	—	—
·76	726·6	987·7	2248·2	1885·6	—	—
·77	198·1	364·4	5595·6	5538·9	—	—
·78	40·5	115·3	11311·7	11958·6	—	—
·79	6·0	31·3	18071·0	18977·4	—	—
·80	·0	7·3	22139·3	22135·7	—	—
·81	—	1·4	19920·7	18977·4	—	—
·82	—	·2	12665·6	11958·6	—	—
·83	—	·0	5383·5	5538·9	·0	—
·84	—	—	1435·4	1885·6	·1	—
·85	—	—	222·2	471·8	2·6	·0
·86	—	—	18·2	86·8	49·7	·6
·87	—	—	·7	11·7	658·1	290·2
·88	—	—	·0	1·2	5308·0	4598·7
·89	—	—	—	·1	22606·9	24134·5
·90	—	—	—	·0	41873·1	41941·4
·91	—	—	—	—	25806·1	24134·5
·92	—	—	—	—	3626·0	4598·7
·93	—	—	—	—	66·8	290·2
·94	—	—	—	—	·1	·6
·95	—	—	—	—	·0	·0
·96	—	—	—	—	—	—
·97	—	—	—	—	—	—
·98	—	—	—	—	—	—
·99	—	—	—	—	—	—
1·00	·0	·0	·0	·0	·0	·0

* The columns headed 'normal' mark how roughly the Gaussian frequency describes the distribution of the correlation even for large samples, if the correlation be not small in the sampled population.

For the constants of the curves for $n = 400$: see p. 372 above.

TABLE B*. *To assist the calculation of the Ordinates of the Correlation Frequency Curves from Expansion Formulae.*

$\log \frac{n-2}{\sqrt{n-1}}$. $\rho = 0$. $\log (1-\rho^2)^{\frac{n-1}{2}} = 0$.

n	$\log \frac{n-2}{\sqrt{n-1}}$	n	$\log \frac{n-2}{\sqrt{n-1}}$	n	$\log \frac{n-2}{\sqrt{n-1}}$	r	$\log \chi_1$	$\log \chi_2$	ϕ_1	ϕ_2	ϕ_3	ϕ_4
3	$\bar{1}\cdot8494850$	42	·7956681	81	·9460821	−·95	·5054977	$\bar{2}\cdot8825969$				
4	·0624694	43	·8011592	82	·9488475	−·90	·3606232	$\bar{1}\cdot3172203$				
5	·1760913	44	·8065151	83	·9515781	−·85	·2783685	$\bar{1}\cdot5639844$				
6	·2525750	45	·8117421	84	·9542748	−·80	·2218487	$\bar{1}\cdot7335437$				
7	·3098944	46	·8168464	85	·9569384	−·75	·1795110	$\bar{1}\cdot8605570$				
8	·3556022	47	·8218336	86	·9595698	−·70	·1462149	$\bar{1}\cdot9604452$				
9	·3935530	48	·8267089	87	·9621697	−·65	·1192240	·0414179				
10	·4259687	49	·8314772	88	·9647388	−·60	·0969100	·1083599				
11	·4542425	50	·8361432	89	·9672779	−·55	·0782279	·1644063				
12	·4793037	51	·8407111	90	·9697877	−·50	·0624694	·2116818				
13	·5018021	52	·8451849	91	·9722688	−·45	·0491347	·2516860				
14	·5222096	53	·8495685	92	·9747218	−·40	·0378604	·2855089				
15	·5408793	54	·8538654	93	·9771475	−·35	·0283764	·3139606				
16	·5580824	55	·8580790	94	·9795464	−·30	·0204793	·3376520				
17	·5740313	56	·8622124	95	·9819190	−·25	·0140144	·3570469				
18	·5888955	57	·8662687	96	·9842661	−·20	·0088644	·3724968				
19	·6028127	58	·8702506	97	·9865880	−·15	·0049416	·3842651				
20	·6158957	59	·8741609	98	·9888854	−·10	·0021824	·3925427				
21	·6282386	60	·8780020	99	·9911587	−·05	·0005435	·3974593				
22	·6399203	61	·8817764	100	·9934085	·00	·0	·3990899				
23	·6510080	62	·8854863	400	1·2993966	+·05	·0005435	·3974593				
24	·6615588	63	·8891340			+·10	·0021824	·3925427				
25	·6716222	64	·8927214			+·15	·0049416	·3842651				
26	·6812412	65	·8962506			+·20	·0088644	·3724968				
27	·6904533	66	·8997233			+·25	·0140144	·3570469				
28	·6992915	67	·9031414			+·30	·0204793	·3376520				
29	·7077847	68	·9065065			+·35	·0283764	·3139606				
30	·7159590	69	·9098203			+·40	·0378604	·2855089				
31	·7238374	70	·9130844			+·45	·0491347	·2516860				
32	·7314404	71	·9163001			+·50	·0624694	·2116818				
33	·7387867	72	·9194689			+·55	·0782279	·1644063				
34	·7458930	73	·9225921			+·60	·0969100	·1083599				
35	·7527745	74	·9256711			+·65	·1192240	·0414179				
36	·7594449	75	·9287070			+·70	·1462149	$\bar{1}\cdot9604452$				
37	·7659168	76	·9317011			+·75	·1795110	$\bar{1}\cdot8605570$				
38	·7722016	77	·9346545			+·80	·2218487	$\bar{1}\cdot7335437$				
39	·7783099	78	·9375682			+·85	·2783685	$\bar{1}\cdot5639844$				
40	·7842513	79	·9404434			+·90	·3606232	$\bar{1}\cdot3172203$				
41	·7900346	80	·9432811			+·95	·5054977	$\bar{2}\cdot8825969$				

$\phi_1 = .25$ $\phi_2 = .03125$ $\phi_3 = -.0390625$ $\phi_4 = -.0102539$

* If the ordinate at r be y, then (see p. 348)

$$y = Y\left(1 + \frac{\phi_1}{n-1} + \frac{\phi_2}{(n-1)^2} + \frac{\phi_3}{(n-1)^3} + \frac{\phi_4}{(n-1)^4}\right),$$

where $$\log Y = \log \frac{n-2}{\sqrt{n-1}} + \log (1-\rho^2)^{\frac{n-1}{2}} - (n-1)\log \chi_1 - \log \chi_2.$$

All these quantities are given for $r = -\cdot95$ to $+\cdot95$ and $\rho = 0\cdot0$ to $0\cdot9$ in this Table B.

* The columns headed 'normal' mark how roughly the Gaussian frequency describes the distribution of the correlation even for large samples, if the correlation be not small in the sampled population.
For the constants of the curves for $n = 400$: see p. 372 above.

TABLE B. *To assist the calculation of the Ordinates of the Correlation Frequency Curves from Expansion Formulae.*

	$\rho = \cdot 1.$ $\log (1-\rho^2)^{\frac{3}{2}} = \bar{1}\cdot 9934528.$							$\rho = \cdot 2.$ $\log (1-\rho^2)^{\frac{3}{2}} = \bar{1}\cdot 9734068.$			
r	$\log \chi_1$	$\log \chi_2$	ϕ_1	ϕ_2	ϕ_3	ϕ_4	r	$\log \chi_1$	$\log \chi_2$	ϕ_1
$-\cdot 95$	·5470942	$\bar{1}$·8563426	·238125	·0229783	−·0364766	−·0013075	$-\cdot 95$	·5899090	$\bar{1}$·8182302	·22625
$-\cdot 90$	·4002321	$\bar{1}$·2919599	·23875	·0233820	−·0366462	−·0017344	$-\cdot 90$	·4413696	$\bar{1}$·2546862	·2275
$-\cdot 85$	·3159806	$\bar{1}$·5397223	·239375	·0237893	−·0368123	−·0021666	$-\cdot 85$	·3554188	$\bar{1}$·5032983	·22875
$-\cdot 80$	·2574549	$\bar{1}$·7102846	·24	·0242	−·0369750	−·0026040	$-\cdot 80$	·2951711	$\bar{1}$·6747215	·23
$-\cdot 75$	·2131018	$\bar{1}$·8383056	·240625	·0246143	−·0371342	−·0030466	$-\cdot 75$	·2490732	$\bar{1}$·8036150	·23125
$-\cdot 70$	·1777811	$\bar{1}$·9392061	·24125	·0250320	−·0372898	−·0034943	$-\cdot 70$	·2119841	$\bar{1}$·9053996	·2325
$-\cdot 65$	·1487560	·0211959	·241875	·0254533	−·0374417	−·0039470	$-\cdot 65$	·1811668	$\bar{1}$·9882856	·23375
$-\cdot 60$	·1243983	·0891598	·2425	·0258781	−·0375900	−·0044047	$-\cdot 60$	·1549924	·0571577	·235
$-\cdot 55$	·1036628	·1462328	·243125	·0263064	−·0377346	−·0048672	$-\cdot 55$	·1324153	·1151516	·23625
$-\cdot 50$	·0858411	·1945400	·24375	·0267383	−·0378754	−·0053345	$-\cdot 50$	·1127264	·1643923	·2375
$-\cdot 45$	·0704333	·2355806	·244375	·0271736	−·0380123	−·0058066	$-\cdot 45$	·0954255	·2063796	·23875
$-\cdot 40$	·0570761	·2704450	·245	·0276125	−·0381453	−·0062833	$-\cdot 40$	·0801485	·2422038	·24
$-\cdot 35$	·0454992	·2999432	·245625	·0280549	−·0382744	−·0067646	$-\cdot 35$	·0666246	·2726756	·24125
$-\cdot 30$	·0354989	·3246862	·24625	·0285008	−·0383994	−·0072503	$-\cdot 30$	·0546496	·2984059	·2425
$-\cdot 25$	·0269206	·3451377	·246875	·0289502	−·0385204	−·0077405	$-\cdot 25$	·0440680	·3198590	·24375
$-\cdot 20$	·0196470	·3616495	·2475	·0294031	−·0386373	−·0082349	$-\cdot 20$	·0347621	·3373870	·245
$-\cdot 15$	·0135901	·3744849	·248125	·0298596	−·0387500	−·0087336	$-\cdot 15$	·0266432	·3512533	·24625
$-\cdot 10$	·0086862	·3838348	·24875	·0303195	−·0388585	−·0092363	$-\cdot 10$	·0196470	·3616495	·2475
$-\cdot 05$	·0048920	·3898291	·249375	·0307830	−·0389627	−·0097431	$-\cdot 05$	·0137293	·3687055	·24875
$\cdot 00$	·0021824	·3925427	·25	·03125	−·0390625	−·0102539	$\cdot 00$	·0088644	·3724968	·25
$+\cdot 05$	·0005490	·3920005	·250625	·0317205	−·0391579	−·0107685	$+\cdot 05$	·0050431	·3730485	·25125
$+\cdot 10$	·0	·3881779	·25125	·0321945	−·0392490	−·0112869	$+\cdot 10$	·0022729	·3703365	·2525
$+\cdot 15$	·0005603	·3809998	·251875	·0326721	−·0393354	−·0118089	$+\cdot 15$	·0005777	·3642861	·25375
$+\cdot 20$	·0022729	·3703365	·2525	·0331531	−·0394174	−·0123344	$+\cdot 20$	·0	·3547680	·255
$+\cdot 25$	·0052014	·3559973	·253125	·0336377	−·0394947	−·0128634	$+\cdot 25$	·0006024	·3415919	·25625
$+\cdot 30$	·0094334	·3377189	·25375	·0341258	−·0395674	−·0133957	$+\cdot 30$	·0024715	·3244949	·2575
$+\cdot 35$	·0150862	·3151498	·254375	·0346174	−·0396353	−·0139313	$+\cdot 35$	·0057238	·3031260	·25875
$+\cdot 40$	·0223140	·2878260	·255	·0351125	−·0396984	−·0144700	$+\cdot 40$	·0105126	·2770218	·26
$+\cdot 45$	·0313204	·2551371	·255625	·0356111	−·0397568	−·0150118	$+\cdot 45$	·0170404	·2455721	·26125
$+\cdot 50$	·0423754	·2162728	·25625	·0361133	−·0398102	−·0155564	$+\cdot 50$	·0255763	·2079674	·2625
$+\cdot 55$	·0558421	·1701431	·256875	·0366189	−·0398587	−·0161038	$+\cdot 55$	·0364823	·1631181	·26375
$+\cdot 60$	·0722203	·1152488	·2575	·0371281	−·0399021	−·0166540	$+\cdot 60$	·0502571	·1095254	·265
$+\cdot 65$	·0922180	·0494649	·258125	·0376408	−·0399406	−·0172067	$+\cdot 65$	·0676076	·0450651	·26625
$+\cdot 70$	·1168803	$\bar{1}$·9696565	·25875	·0381570	−·0399739	−·0177618	$+\cdot 70$	·0895777	$\bar{1}$·9666028	·2675
$+\cdot 75$	·1478351	$\bar{1}$·8709390	·259375	·0386768	−·0400021	−·0183193	$+\cdot 75$	·1177943	$\bar{1}$·8692544	·26875
$+\cdot 80$	·1878190	$\bar{1}$·7451026	·26	·0392	−·0400250	−·0188790	$+\cdot 80$	·1549924	$\bar{1}$·7448109	·27
$+\cdot 85$	·2419720	$\bar{1}$·5767267	·260625	·0397268	−·0400427	−·0194408	$+\cdot 85$	·2063110	$\bar{1}$·5778522	·27125
$+\cdot 90$	·3218470	$\bar{1}$·3311524	·26125	·0402570	−·0400550	−·0200045	$+\cdot 90$	·2833014	$\bar{1}$·3337203	·2725
$+\cdot 95$	·4643287	$\bar{2}$·8977254	·261875	·0407908	−·0400620	−·0205702	$+\cdot 95$	·4228471	$\bar{2}$·9017612	·27375

TABLE B—(*continued*).

$\rho = \cdot 2$. $\log(1-\rho^2)^{\frac{3}{2}} = \bar{1}\cdot 9734068$.						$\rho = \cdot 3$. $\log(1-\rho^2)^{\frac{3}{2}} = \bar{1}\cdot 9385621$.			
ϕ_2	ϕ_3	ϕ_4	r	$\log \chi_1$	$\log \chi_2$	ϕ_1	ϕ_2	ϕ_3	ϕ_4
·0159758	−·0326811	+·0057193	−·95	·6348801	$\bar{2}$·7667074	·214375	·0102424	−·0280527	+·0104960
·0166531	−·0331264	+·0050816	−·90	·4849062	$\bar{1}$·2038806	·21625	·0110633	−·0288235	+·0098985
·0173445	−·0335620	+·0044192	−·85	·3974915	$\bar{1}$·4532246	·218125	·0119158	−·0295824	+·0092418
·01805	−·0339875	+·0037321	−·80	·3357497	$\bar{1}$·6253949	·22	·0128	−·0303250	+·0085260
·0187695	−·0344025	+·0030208	−·75	·2881264	$\bar{1}$·7550511	·221875	·0137158	−·0310528	+·0077516
·0195031	−·0348065	+·0022856	−·70	·2494796	$\bar{1}$·8576146	·22375	·0146633	−·0317633	+·0069189
·0202508	−·0351990	+·0015269	−·65	·2170712	$\bar{1}$·9412961	·225625	·0156424	−·0324549	+·0060287
·0210125	−·0355797	+·0007451	−·60	·1892713	·0109810	·2275	·0166531	−·0331264	+·0050816
·0217883	−·0359481	−·0000593	−·55	·1650331	·0698054	·229375	·0176955	−·0337760	+·0040787
·0225781	−·0363037	−·0008860	−·50	·1436465	·1198950	·23125	·0187695	−·0344025	+·0030208
·0233820	−·0366462	−·0017344	−·45	·1246098	·1627501	·233125	·0198752	−·0350042	+·0019092
·0242	−·0369750	−·0026040	−·40	·1075577	·1994619	·235	·0210125	−·0355797	+·0007451
·0250320	−·0372898	−·0034943	−·35	·0922180	·2308416	·236875	·0221814	−·0361275	−·0004699
·0258781	−·0375900	−·0044047	−·30	·0783851	·2575009	·23875	·0233820	−·0366462	−·0017344
·0267383	−·0378754	−·0053345	−·25	·0659021	·2799047	·240625	·0246143	−·0371342	−·0030466
·0276125	−·0381453	−·0062833	−·20	·0546496	·2984059	·2425	·0258781	−·0375900	−·0044047
·0285008	−·0383994	−·0072503	−·15	·0445372	·3132690	·244375	·0271736	−·0380123	−·0058066
·0294031	−·0386373	−·0082349	−·10	·0354989	·3246862	·24625	·0285008	−·0383994	−·0072503
·0303195	−·0388585	−·0092363	−·05	·0274889	·3327884	·248125	·0298596	−·0387500	−·0087336
·03125	−·0390625	−·0102539	·00	·0204793	·3376520	·25	·03125	−·0390625	−·0102539
·0321945	−·0392490	−·0112869	+·05	·0144591	·3393033	·251875	·0326721	−·0393354	−·0118089
·0331531	−·0394170	−·0123344	+·10	·0094334	·3377189	·25375	·0341258	−·0395674	−·0133957
·0341258	−·0395674	−·0133957	+·15	·0054243	·3328255	·255625	·0356111	−·0397568	−·0150118
·0351125	−·0396984	−·0144700	+·20	·0024715	·3244949	·2575	·0371281	−·0399021	−·0166540
·0361133	−·0398102	−·0155564	+·25	·0006354	·3125381	·259375	·0386768	−·0400021	−·0183193
·0371281	−·0399021	−·0166540	+·30	·0	·2966934	·26125	·0402570	−·0400550	−·0200045
·0381570	−·0399739	−·0177618	+·35	·0006788	·2766112	·263125	·0418689	−·0400595	−·0217064
·0392	−·0400250	−·0188790	+·40	·0028223	·2518296	·265	·0435125	−·0400141	−·0234213
·0402570	−·0400550	−·0200045	+·45	·0066301	·2217400	·266875	·0451877	−·0399172	−·0251457
·0413281	−·0400635	−·0211375	+·50	·0123676	·1855345	·26875	·0468945	−·0397675	−·0268757
·0424133	−·0400500	−·0222767	+·55	·0203937	·1421251	·270625	·0486330	−·0395633	−·0286077
·0435125	−·0400141	−·0234213	+·60	·0312032	·0900151	·2725	·0504031	−·0393033	−·0303374
·0446258	−·0399553	−·0245700	+·65	·0454992	·0270821	·274375	·0522049	−·0389860	−·0320608
·0457531	−·0398732	−·0257219	+·70	·0643213	$\bar{1}$·9501937	·27625	·0540383	−·0386098	−·0337735
·0468945	−·0397675	−·0268757	+·75	·0892920	$\bar{1}$·8544683	·278125	·0559033	−·0381733	−·0354711
·04805	−·0396375	−·0280304	+·80	·1231416	$\bar{1}$·7316990	·28	·0578	−·0376750	−·0371490
·0492195	−·0394829	−·0291847	+·85	·1710041	$\bar{1}$·5664684	·281875	·0597283	−·0371134	−·0388026
·0504031	−·0393033	−·0303374	+·90	·2444254	$\bar{1}$·3241210	·28375	·0616883	−·0364871	−·0404269
·0516008	−·0390982	−·0314873	+·95	·3802830	1·8940059	·285625	·0636799	−·0357945	−·0420171

TABLE B. *To assist the calculation of the Ordinates of the Correlation Frequency Curves from Expansion Formulae.*

	$\rho = \cdot 4$. $\log (1-\rho^2)^{\frac{3}{2}} = \bar{1}\cdot 8864189$.						$\rho = \cdot 5$. $\log (1-\rho^2)^{\frac{3}{2}} = \bar{1}\cdot 8125919$.			
r	$\log \chi_1$	$\log \chi_2$	ϕ_1	ϕ_2	ϕ_3	ϕ_4	r	$\log \chi_1$	$\log \chi_2$	ϕ_1 .
$-\cdot 95$	·6832371	$\bar{2}\cdot 6990762$	·2025	·0057781	$-\cdot 0229682$	$+\cdot 0129113$	$-\cdot 95$	·7367591	$\bar{2}\cdot 6107927$	·190625
$-\cdot 90$	·5320225	$\bar{1}\cdot 1368698$	·205	·0066125	$-\cdot 0240578$	$+\cdot 0125970$	$-\cdot 90$	·5844606	$\bar{1}\cdot 0491282$	·19375
$-\cdot 85$	·4433337	$\bar{1}\cdot 3868509$	·2075	·0075031	$-\cdot 0251404$	$+\cdot 0121802$	$-\cdot 85$	·4946527	$\bar{1}\cdot 2996689$	·196875
$-\cdot 80$	·3802830	$\bar{1}\cdot 5596756$	·21	·00845	$-\cdot 0262125$	$+\cdot 0116596$	$-\cdot 80$	·4304462	$\bar{1}\cdot 4730716$	·2
$-\cdot 75$	·3313147	$\bar{1}\cdot 6900043$	·2125	·0094531	$-\cdot 0272705$	$+\cdot 0110342$	$-\cdot 75$	·3802830	$\bar{1}\cdot 6039976$	·203125
$-\cdot 70$	·2912852	$\bar{1}\cdot 7932591$	·215	·0105125	$-\cdot 0283109$	$+\cdot 0103034$	$-\cdot 70$	·3390180	$\bar{1}\cdot 7078702$	·20625
$-\cdot 65$	·2574549	$\bar{1}\cdot 8776516$	·2175	·0116281	$-\cdot 0293303$	$+\cdot 0094672$	$-\cdot 65$	·3039093	$\bar{1}\cdot 7929019$	·209375
$-\cdot 60$	·2281921	$\bar{1}\cdot 9480680$	·22	·0128	$-\cdot 0303250$	$+\cdot 0085260$	$-\cdot 60$	·2733227	$\bar{1}\cdot 8639801$	·2125
$-\cdot 55$	·2024481	·0076453	·2225	·0140281	$-\cdot 0312916$	$+\cdot 0074804$	$-\cdot 55$	·2462074	$\bar{1}\cdot 9242431$	·215625
$-\cdot 50$	·1795110	·0585101	·225	·0153125	$-\cdot 0322266$	$+\cdot 0063318$	$-\cdot 50$	·2218487	$\bar{1}\cdot 9758187$	·21875
$-\cdot 45$	·1588770	·1021639	·2275	·0166531	$-\cdot 0331264$	$+\cdot 0050816$	$-\cdot 45$	·1997401	·0202098	·221875
$-\cdot 40$	·1401787	·1396988	·23	·01805	$-\cdot 0339875$	$+\cdot 0037321$	$-\cdot 40$	·1795110	·0585101	·225
$-\cdot 35$	·1231416	·1719271	·2325	·0195031	$-\cdot 0348065$	$+\cdot 0022856$	$-\cdot 35$	·1608837	·0915336	·228125
$-\cdot 30$	·1075577	·1994619	·235	·0210125	$-\cdot 0355797$	$+\cdot 0007451$	$-\cdot 30$	·1436465	·1198950	·23125
$-\cdot 25$	·0932674	·2227694	·2375	·0225781	$-\cdot 0363037$	$-\cdot 0008860$	$-\cdot 25$	·1276363	·1440625	·234375
$-\cdot 20$	·0801485	·2422038	·24	·0242	$-\cdot 0369750$	$-\cdot 0026040$	$-\cdot 20$	·1127264	·1643923	·2375
$-\cdot 15$	·0681078	·2580318	·2425	·0258781	$-\cdot 0375900$	$-\cdot 0044047$	$-\cdot 15$	·0988194	·1811527	·240625
$-\cdot 10$	·0570761	·2704450	·245	·0276125	$-\cdot 0381453$	$-\cdot 0062833$	$-\cdot 10$	·0858411	·1945400	·24375
$-\cdot 05$	·0470041	·2795781	·2475	·0294031	$-\cdot 0386373$	$-\cdot 0082349$	$-\cdot 05$	·0737368	·2046893	·246875
$\cdot 00$	·0378604	·2855089	·25	·03125	$-\cdot 0390625$	$-\cdot 0102539$	$\cdot 00$	·0624694	·2116818	·25
$+\cdot 05$	·0296300	·2882652	·2525	·0331531	$-\cdot 0394174$	$-\cdot 0123344$	$+\cdot 05$	·0520175	·2155489	·253125
$+\cdot 10$	·0223140	·2878260	·255	·0351125	$-\cdot 0396984$	$-\cdot 0144700$	$+\cdot 10$	·0423754	·2162728	·25625
$+\cdot 15$	·0159298	·2841201	·2575	·0371281	$-\cdot 0399021$	$-\cdot 0166540$	$+\cdot 15$	·0335527	·2137861	·259375
$+\cdot 20$	·0105126	·2770218	·26	·0392	$-\cdot 0400250$	$-\cdot 0188790$	$+\cdot 20$	·0255763	·2079674	·2625
$+\cdot 25$	·0061172	·2663445	·2625	·0413281	$-\cdot 0400635$	$-\cdot 0211375$	$+\cdot 25$	·0184918	·1986347	·265625
$+\cdot 30$	·0028223	·2518296	·265	·0435125	$-\cdot 0400141$	$-\cdot 0234213$	$+\cdot 30$	·0123676	·1855345	·26875
$+\cdot 35$	·0007352	·2331303	·2675	·0457531	$-\cdot 0398732$	$-\cdot 0257219$	$+\cdot 35$	·0072998	·1683255	·271875
$+\cdot 40$	·0	·2097881	·27	·04805	$-\cdot 0396375$	$-\cdot 0280304$	$+\cdot 40$	·0034197	·1465558	·275
$+\cdot 45$	·0008089	·1811980	·2725	·0504031	$-\cdot 0393033$	$-\cdot 0303374$	$+\cdot 45$	·0009057	·1196270	·278125
$+\cdot 50$	·0034197	·1465558	·275	·0528125	$-\cdot 0388672$	$-\cdot 0326331$	$+\cdot 50$	·0	·0867431	·28125
$+\cdot 55$	·0081829	·1047779	·2775	·0552781	$-\cdot 0383256$	$-\cdot 0349072$	$+\cdot 55$	·0010353	·0468291	·284375
$+\cdot 60$	·0155840	·0543720	·28	·0578	$-\cdot 0376750$	$-\cdot 0371490$	$+\cdot 60$	·0044774	$\bar{1}\cdot 9984028$	·2875
$+\cdot 65$	·0263161	$\bar{1}\cdot 9932210$	·2825	·0603781	$-\cdot 0369119$	$-\cdot 0393475$	$+\cdot 65$	·0109971	$\bar{1}\cdot 9393579$	·290625
$+\cdot 70$	·0414078	$\bar{1}\cdot 9181979$	·285	·0630125	$-\cdot 0360328$	$-\cdot 0414911$	$+\cdot 70$	·0215976	$\bar{1}\cdot 8665804$	·29375
$+\cdot 75$	·0624694	$\bar{1}\cdot 8244269$	·2875	·0657031	$-\cdot 0350342$	$-\cdot 0435679$	$+\cdot 75$	·0378604	$\bar{1}\cdot 7752089$	·296875
$+\cdot 80$	·0922180	$\bar{1}\cdot 7037082$	·29	·06845	$-\cdot 0339125$	$-\cdot 0455654$	$+\cdot 80$	·0624694	$\bar{1}\cdot 6570600$	·3
$+\cdot 85$	·1357728	$\bar{1}\cdot 5406314$	·2925	·0712531	$-\cdot 0326643$	$-\cdot 0474709$	$+\cdot 85$	·1005057	$\bar{1}\cdot 4967424$	·303125
$+\cdot 90$	·2046635	$\bar{1}\cdot 3005493$	·295	·0741125	$-\cdot 0312859$	$-\cdot 0492710$	$+\cdot 90$	·1634553	$\bar{1}\cdot 2596309$	30625
$+\cdot 95$	·3357497	$\bar{2}\cdot 8728199$	·2975	·0770281	$-\cdot 0297740$	$-\cdot 0509521$	$+\cdot 95$	·2881264	$\bar{2}\cdot 8351091$	·309375

TABLE B—(*continued*).

$\rho = \cdot 5$. $\log(1-\rho^2)^{\frac{3}{2}} = \bar{1}\cdot 8125919$.						$\rho = \cdot 6$. $\log(1-\rho^2)^{\frac{3}{2}} = \bar{1}\cdot 7092700$.			
ϕ_2	ϕ_3	ϕ_4	r	$\log \chi_1$	$\log \chi_2$	ϕ_1	ϕ_2	ϕ_3	ϕ_4
·0025830	−·0178043	+·0130733	−·95	·7983074	$\bar{2}$·4939170	·17875	·0006570	−·0129380	+·0113090
·0033008	−·0191498	+·0132346	−·90	·6450539	$\bar{2}$·9327299	·1825	·0011281	−·0148103	+·0120455
·0041064	−·0205090	+·0132540	−·85	·5542555	$\bar{1}$·1837659	·18625	·0017258	−·0159569	+·0126231
·005	−·0218750	+·0131250	−·80	·4890205	$\bar{1}$·3576828	·19	·00245	−·0175375	+·0130246
·0059814	−·0232410	+·0128423	−·75	·4377890	$\bar{1}$·4891430	·19375	·0033008	−·0191498	+·0132346
·0070508	−·0246002	+·0124015	−·70	·3954124	$\bar{1}$·5935710	·1975	·0042781	−·0207818	+·0132403
·0082080	−·0259457	+·0117995	−·65	·3591488	$\bar{1}$·6791805	·20125	·0053820	−·0224218	+·0130306
·0094531	−·0272705	+·0110342	−·60	·3273589	$\bar{1}$·7508604	·205	·0066125	−·0240578	+·0125970
·0107861	−·0285679	+·0101042	−·55	·2989895	$\bar{1}$·8117504	·20875	·0079695	−·0256780	+·0119330
·0122070	−·0298309	+·0090097	−·50	·2733227	$\bar{1}$·8639801	·2125	·0094531	−·0272705	+·0110342
·0137158	−·0310528	+·0077516	−·45	·2498484	$\bar{1}$·9090541	·21625	·0110633	−·0288235	+·0098985
·0153125	−·0322266	+·0063318	−·40	·2281921	$\bar{1}$·9480680	·22	·0128	−·0303250	+·0085260
·0169971	−·0333454	+·0047535	−·35	·2080718	$\bar{1}$·9818379	·22375	·0146633	−·0317633	+·0069189
·0187695	−·0344025	+·0030208	−·30	·1892713	·0109810	·2275	·0166531	−·0331264	+·0050816
·0206299	−·0353909	+·0011389	−·25	·1716222	·0359679	·23125	·0187695	−·0344025	+·0030208
·0225781	−·0363037	−·0008860	−·20	·1549924	·0571577	·235	·0210125	−·0355797	+·0007451
·0246143	−·0371342	−·0030466	−·15	·1392781	·0748218	·23875	·0233820	−·0366462	−·0017344
·0267383	−·0378754	−·0053345	−·10	·1243983	·0891598	·2425	·0258781	−·0375900	−·0044047
·0289502	−·0385204	−·0077405	−·05	·1102908	·1003106	·24625	·0285008	−·0383994	−·0072503
·03125	−·0390625	−·0102539	·00	·0969100	·1083599	·25	·03125	−·0390625	−·0102539
·0336377	−·0394947	−·0128634	+·05	·0842253	·1133434	·25375	·0341258	−·0395674	−·0133957
·0361133	−·0398102	−·0155564	+·10	·0722203	·1152488	·2575	·0371281	−·0399021	−·0166540
·0386768	−·0400021	−·0183193	+·15	·0608930	·1140143	·26125	·0402570	−·0400550	−·0200045
·0413281	−·0400635	−·0211375	+·20	·0502571	·1095254	·265	·0435125	−·0400141	−·0234213
·0440674	−·0399876	−·0239952	+·25	·0403433	·1016073	·26875	·0468945	−·0397675	−·0268757
·0468945	−·0397675	−·0268757	+·30	·0312032	·0900151	·2725	·0504031	−·0393033	−·0303374
·0498096	−·0393963	−·0297613	+·35	·0229135	·0744170	·27625	·0540383	−·0386098	−·0337735
·0528125	−·0388672	−·0326331	+·40	·0155840	·0543720	·28	·0578	−·0376750	−·0371490
·0559033	−·0381733	−·0354711	+·45	·0093675	·0292945	·28375	·0616883	−·0364871	−·0404269
·0590820	−·0373077	−·0382544	+·50	·0044774	$\bar{1}$·9984028	·2875	·0657031	−·0350342	−·0435679
·0623486	−·0362637	−·0409610	+·55	·0012127	$\bar{1}$·9606388	·29125	·0698445	−·0333044	−·0465305
·0657031	−·0350342	−·0435679	+·60	·0	$\bar{1}$·9145399	·295	·0741125	−·0312859	−·0492710
·0691455	−·0336124	−·0460509	+·65	·0014639	$\bar{1}$·8580230	·29875	·0785070	−·0289669	−·0517436
·0726758	−·0319916	−·0483849	+·70	·0065529	$\bar{1}$·7880012	·3025	·0830281	−·0263353	−·0539003
·0762939	−·0301647	−·0505437	+·75	·0167837	$\bar{1}$·6996456	·30625	·0876758	−·0233795	−·0556908
·08	−·0281250	−·0525000	+·80	·0347621	$\bar{1}$·5848120	·31	·09245	−·0200875	−·0570629
·0837939	−·0258656	−·0542255	+·85	·0654746	$\bar{1}$·4281563	·31375	·0973508	−·0164474	−·0579619
·0876758	−·0233795	−·0556908	+·90	·1202910	$\bar{1}$·1951114	·3175	·1023781	−·0120568	−·0583312
·0916455	−·0206600	−·0568656	+·95	·2358762	$\bar{2}$·7751326	·32125	·1075320	−·0080757	−·0581117

TABLE B. *To assist the calculation of the Ordinates of the Correlation Frequency Curves from Expansion Formulae.*

	$\rho = \cdot 7$. $\log (1-\rho^2)^{\frac{3}{2}} = \bar{1}\cdot 5613553$.						$\rho = \cdot 8$. $\log (1-\rho^2)^{\frac{3}{2}} = \bar{1}\cdot 3344538$.		
r	$\log \chi_1$	$\log \chi_2$	ϕ_1	ϕ_2	ϕ_3	ϕ_4	r	$\log \chi_1$	$\log \chi_2$	ϕ_1
$-\cdot 95$	·8731268	$\bar{2}$·3332450	·166875	·0000002	−·0087458	+·0081651	$-\cdot 95$	·9728591	$\bar{2}$·0942943	·155
$-\cdot 90$	·7190257	$\bar{2}$·7724818	·17125	·0000945	−·0101880	+·0094402	$-\cdot 90$	·8180004	$\bar{2}$·5339099	·16
$-\cdot 85$	·6273441	$\bar{1}$·0239593	·175625	·0003611	−·0117540	+·0105881	$-\cdot 85$	·7255265	$\bar{2}$·7857835	·165
$-\cdot 80$	·5611883	$\bar{1}$·1983367	·18	·0008	−·0134250	+·0115710	$-\cdot 80$	·6585413	$\bar{2}$·9605755	·17
$-\cdot 75$	·5089957	$\bar{1}$·3302774	·184375	·0014111	−·0151821	+·0123553	$-\cdot 75$	·6054797	$\bar{1}$·0929508	·175
$-\cdot 70$	·4656161	$\bar{1}$·4352073	·18875	·0021945	−·0170065	+·0129113	$-\cdot 70$	·5611883	$\bar{1}$·1983367	·18
$-\cdot 65$	·4283019	$\bar{1}$·5213417	·193125	·0031502	−·0188794	+·0132135	$-\cdot 65$	·5229163	$\bar{1}$·2849499	·185
$-\cdot 60$	·3954124	$\bar{1}$·5935710	·1975	·0042781	−·0207818	+·0132403	$-\cdot 60$	·4890205	$\bar{1}$·3576828	·19
$-\cdot 55$	·3658926	$\bar{1}$·6550366	·201875	·0055783	−·0226951	+·0129741	$-\cdot 55$	·4584391	$\bar{1}$·4196788	·195
$-\cdot 50$	·3390180	$\bar{1}$·7078702	·20625	·0070508	−·0246002	+·0124015	$-\cdot 50$	·4304462	$\bar{1}$·4730716	·2
$-\cdot 45$	·3142753	$\bar{1}$·7535784	·210625	·0086955	−·0264785	+·0115131	$-\cdot 45$	·4045223	$\bar{1}$·5193703	·205
$-\cdot 40$	·2912852	$\bar{1}$·7932591	·215	·0105125	−·0283109	+·0103034	$-\cdot 40$	·3802830	$\bar{1}$·5596756	·21
$-\cdot 35$	·2697607	$\bar{1}$·8277312	·219375	·0125018	−·0300788	+·0087711	$-\cdot 35$	·3574352	$\bar{1}$·5948094	·215
$-\cdot 30$	·2494796	$\bar{1}$·8576146	·22375	·0146633	−·0317633	+·0069189	$-\cdot 30$	·3357497	$\bar{1}$·6253949	·22
$-\cdot 25$	·2302671	$\bar{1}$·8833832	·228125	·0169971	−·0333454	+·0047535	$-\cdot 25$	·3150444	$\bar{1}$·6519100	·225
$-\cdot 20$	·2119841	$\bar{1}$·9053996	·2325	·0195031	−·0348065	+·0022856	$-\cdot 20$	·2951711	$\bar{1}$·6747215	·23
$-\cdot 15$	·1945188	$\bar{1}$·9239392	·236875	·0221814	−·0361275	−·0004699	$-\cdot 15$	·2760084	$\bar{1}$·6941098	·235
$-\cdot 10$	·1777811	$\bar{1}$·9392061	·24125	·0250320	−·0372898	−·0034943	$-\cdot 10$	·2574549	$\bar{1}$·7102846	·24
$-\cdot 05$	·1616988	$\bar{1}$·9513444	·245625	·0280549	−·0382744	−·0067646	$-\cdot 05$	·2394256	$\bar{1}$·7233964	·245
$\cdot 00$	·1462149	$\bar{1}$·9604452	·25	·03125	−·0390625	−·0102539	$\cdot 00$	·2218487	$\bar{1}$·7335437	·25
$+\cdot 05$	·1312858	$\bar{1}$·9665509	·254375	·0346174	−·0396353	−·0139313	$+\cdot 05$	·2046635	$\bar{1}$·7407774	·255
$+\cdot 10$	·1168803	$\bar{1}$·9696565	·25875	·0381570	−·0399739	−·0177618	$+\cdot 10$	·1878190	$\bar{1}$·7451026	·26
$+\cdot 15$	·1029796	$\bar{1}$·9697088	·263125	·0418689	−·0400595	−·0217064	$+\cdot 15$	·1712730	$\bar{1}$·7464775	·265
$+\cdot 20$	·0895777	$\bar{1}$·9666028	·2675	·0457531	−·0398732	−·0257219	$+\cdot 20$	·1549924	$\bar{1}$·7448109	·27
$+\cdot 25$	·0766832	$\bar{1}$·9601751	·271875	·0498096	−·0393963	−·0297613	$+\cdot 25$	·1389531	$\bar{1}$·7399556	·275
$+\cdot 30$	·0643213	$\bar{1}$·9501937	·27625	·0540383	−·0386098	−·0337735	$+\cdot 30$	·1231416	$\bar{1}$·7316990	·28
$+\cdot 35$	·0525383	$\bar{1}$·9363424	·280625	·0584393	−·0374949	−·0377031	$+\cdot 35$	·1075577	$\bar{1}$·7197481	·285
$+\cdot 40$	·0414078	$\bar{1}$·9181979	·285	·0630125	−·0360328	−·0414911	$+\cdot 40$	·0922180	$\bar{1}$·7037082	·29
$+\cdot 45$	·0310401	$\bar{1}$·8951960	·289375	·0677580	−·0342047	−·0450741	$+\cdot 45$	·0771634	$\bar{1}$·6830497	·295
$+\cdot 50$	·0215976	$\bar{1}$·8665804	·29375	·0726758	−·0319916	−·0483849	$+\cdot 50$	·0624694	$\bar{1}$·6570600	·30
$+\cdot 55$	·0133179	$\bar{1}$·8313240	·298125	·0777658	−·0293748	−·0513521	$+\cdot 55$	·0482647	$\bar{1}$·6247660	·305
$+\cdot 60$	·0065529	$\bar{1}$·7880012	·3025	·0830281	−·0263353	−·0539003	$+\cdot 60$	·0347621	$\bar{1}$·5848120	·31
$+\cdot 65$	·0018354	$\bar{1}$·7345749	·306875	·0884627	−·0228545	−·0559500	$+\cdot 65$	·0223140	$\bar{1}$·5352510	·315
$+\cdot 70$	·0	$\bar{1}$·6680154	·31125	·0940695	−·0189134	−·0574179	$+\cdot 70$	·0115163	$\bar{1}$·4731726	·32
$+\cdot 75$	·0024195	$\bar{1}$·5835655	·315625	·0998486	−·0144932	−·0582164	$+\cdot 75$	·0034197	$\bar{1}$·3939808	·325
$+\cdot 80$	·0115163	$\bar{1}$·4731726	·32	·1058	−·0095750	−·0582540	$+\cdot 80$	·0	$\bar{1}$·2898462	·33
$+\cdot 85$	·0320384	$\bar{1}$·3216122	·324375	·1119236	−·0041400	−·0574351	$+\cdot 85$	·0053672	$\bar{1}$·1458632	·335
$+\cdot 90$	·0750398	$\bar{1}$·0944747	·32875	·1182195	+·0018306	−·0556601	$+\cdot 90$	·0296300	$\bar{2}$·9280951	·34
$+\cdot 95$	·1767574	$\bar{2}$·6814297	·333125	·1246877	+·0083557	−·0528253	$+\cdot 95$	·1075577	$\bar{2}$·5269450	·345

TABLE B—(*continued*).

$\rho = \cdot 8$. $\log(1-\rho^2)^{\frac{3}{2}} = \bar{1}\cdot 3344538$.						$\rho = \cdot 9$. $\log(1-\rho^2)^{\frac{3}{2}} = \bar{2}\cdot 9181304$.			
ϕ_2	ϕ_3	ϕ_4	r	$\log \chi_1$	$\log \chi_2$	ϕ_1	ϕ_2	ϕ_3	ϕ_4
·0006125	−·0056047	+·0044070	−·95	1·1344648	$\bar{3}$·6665553	·143125	·0024939	−·0038913	+·0010198
·0002	−·0067750	+·0060060	−·90	·9789250	$\bar{2}$·1065114	·14875	·0014445	−·0045010	+·0025068
·0000125	−·0081703	+·0075898	−·85	·8857364	$\bar{2}$·3587425	·154375	·0006799	−·0054756	+·0042099
·00005	−·0097625	+·0090871	−·80	·8180004	$\bar{2}$·5339099	·16	·0002	−·0067750	+·0060060
·0003125	−·0115234	+·0104333	−·75	·7641490	$\bar{2}$·6666800	·165625	·0000049	−·0083591	+·0077831
·0008	−·0134250	+·0115710	−·70	·7190257	$\bar{2}$·7724818	·17125	·0000945	−·0101880	+·0094402
·0015125	−·0154391	+·0124493	−·65	·6798765	$\bar{2}$·8595337	·176875	·0004689	−·0122216	+·0108873
·00245	−·0175375	+·0130246	−·60	·6450539	$\bar{2}$·9327299	·1825	·0011281	−·0148103	+·0120455
·0036125	−·0196922	+·0132598	−·55	·6134923	$\bar{2}$·9952161	·188125	·0020721	−·0167425	+·0128469
·005	−·0218750	+·0131250	−·50	·5844606	$\bar{1}$·0491282	·19375	·0033008	−·0191498	+·0132346
·0066125	−·0240578	+·0125970	−·45	·5574342	$\bar{1}$·0959782	·199375	·0048143	−·0216015	+·0131629
·00845	−·0262125	+·0116596	−·40	·5320225	$\bar{1}$·1368698	·205	·0066125	−·0240578	+·0125970
·0105125	−·0283109	+·0103034	−·35	·5079254	$\bar{1}$·1726281	·210625	·0086955	−·0264785	+·0115131
·0128	−·0303250	+·0085260	−·30	·4849062	$\bar{1}$·2038806	·21625	·0110633	−·0288235	+·0098985
·0153125	−·0322266	+·0063318	−·25	·4627737	$\bar{1}$·2311092	·221875	·0137158	−·0310528	+·0077516
·01805	−·0339875	+·0037321	−·20	·4413696	$\bar{1}$·2546862	·2275	·0166531	−·0331264	+·0050816
·0210125	−·0355797	+·0007451	−·15	·4205607	$\bar{1}$·2748976	·233125	·0198752	−·0350042	+·0019092
·0242	−·0369750	−·0026040	−·10	·4002321	$\bar{1}$·2919599	·23875	·0233820	−·0366462	−·0017344
·0276125	−·0381453	−·0062833	−·05	·3802830	$\bar{1}$·3060315	·244375	·0271736	−·0380123	−·0058066
·03125	−·0390625	−·0102539	·00	·3606232	$\bar{1}$·3172203	·25	·03125	−·0390625	−·0102539
·0351125	−·0396984	−·0144700	+·05	·3411701	$\bar{1}$·3255880	·255625	·0356111	−·0397568	−·0150118
·0392	−·0400250	−·0188790	+·10	·3218470	$\bar{1}$·3311524	·26125	·0402570	−·0400550	−·0200045
·0435125	−·0400141	−·0234213	+·15	·3025809	$\bar{1}$·3338874	·266875	·0451877	−·0399172	−·0251457
·04805	−·0396375	−·0280304	+·20	·2833014	$\bar{1}$·3337203	·2725	·0504031	−·0393033	−·0303374
·0528125	−·0388672	−·0326331	+·25	·2639393	$\bar{1}$·3305264	·278125	·0559033	−·0381733	−·0354711
·0578	−·0376750	−·0371490	+·30	·2444254	$\bar{1}$·3241210	·28375	·0616883	−·0364871	−·0404269
·0630125	−·0360328	−·0414911	+·35	·2246902	$\bar{1}$·3142457	·289375	·0677580	−·0342047	−·0450741
·06845	−·0339125	−·0455654	+·40	·2046635	$\bar{1}$·3005493	·295	·0741125	−·0312859	−·0492710
·0741125	−·0312859	−·0492710	+·45	·1842748	$\bar{1}$·2825579	·300625	·0807518	−·0276909	−·0528645
·08	−·0281250	−·0525000	+·50	·1634553	$\bar{1}$·2596309	·30625	·0876758	−·0233795	−·0556908
·0861125	−·0244016	−·0551378	+·55	·1421425	$\bar{1}$·2308910	·311875	·0948846	−·0183117	−·0575750
·09245	−·0200875	−·0570629	+·60	·1202910	$\bar{1}$·1951114	·3175	·1023781	−·0120568	−·0583312
·0990125	−·0151547	−·0581467	+·65	·0978953	$\bar{1}$·1505243	·323125	·1101564	−·0057467	−·0577622
·1058	−·0095750	−·0582540	+·70	·0750398	$\bar{1}$·0944747	·32875	·1182195	+·0018306	−·0556601
·1128125	−·0033203	−·0572424	+·75	·0520175	$\bar{1}$·0227457	·334375	·1265674	+·0103245	−·0518057
·12005	+·0036375	−·0549629	+·80	·0296300	$\bar{2}$·9280951	·34	·1352	+·0197750	−·0459690
·1275125	+·0113266	−·0512594	+·85	·0100596	$\bar{2}$·7965809	·345625	·1441174	+·0302222	−·0379088
·1352	+·0197750	−·0459690	+·90	·0	$\bar{2}$·5959739	·35125	·1533195	+·0417061	−·0273728
·1431125	+·0290109	−·0389219	+·95	·0274889	$\bar{2}$·2200433	·356875	·1628064	+·0542668	−·0140979

TABLE C. *Position of Origin and Abscissal Unit in terms of Standard Deviation. The first Number gives the Position of the Origin, the second the Abscissal Unit.*

n	$\rho=0$	$\rho=\cdot1$	$\rho=\cdot2$	$\rho=\cdot3$	$\rho=\cdot4$
3	0	·1116225	·2266490	·3490329	·4840501
	·0707107	·0709720	·0717802	·0732142	·0754314
4	0	·1478819	·3011028	·4659475	·6510044
	·0866025	·0870223	·0883242	·0906481	·0942760
5	0	·1778638	·3643600	·5634956	·7915154
	·1000000	·1005663	·1023258	·1054792	·1104330
6	0	·2038711	·4165411	·6485234	·9145610
	·1118034	·1125038	·1146829	·1185985	·1247759
7	0	·2271065	·4645401	·7246924	1·0250662
	·1224745	·1232981	·1258629	·1304802	·1377861
8	0	·2482790	·5083017	·7942029	1·1260506
	·1322876	·1332252	·1361468	·1414136	·1497650
9	0	·2678441	·5487533	·8584888	1·2195137
	·1414214	·1424651	·1457192	·1515911	·1609168
10	0	·2861133	·5865316	·9185423	1·3068548
	·1500000	·1511433	·1547090	·1611481	·1713870
11	0	·3033102	·6220953	·9750815	1·3890961
	·1581139	·1593510	·1632105	·1701841	·1812835
12	0	·3196014	·6557863	1·0286451	1·4670090
	·1658312	·1671572	·1712949	·1787749	·1906890
13	0	·3351148	·6878684	1·0796486	1·5411920
	·1732051	·1746157	·1790180	·1869796	·1996684
14	0	·3499533	·7185489	1·1284203	1·6121199
	·1802776	·1817701	·1864240	·1948454	·2082735
15	0	·3641907	·7479946	1·1752248	1·6801759
	·1870829	·1886516	·1935489	·2024107	·2165466
16	0	·3779001	·7763419	1·2202786	1·7456751
	·1936492	·1952922	·2004222	2097070	·2245228
17	0	·3911338	·8037041	1·2637617	1·8088795
	·2000000	·2017147	·2070688	·2167611	·2322314
18	0	·4039379	·8301762	1·3052186	1·8700099
	·2061553	·2079391	·2135096	·2234913	·2396972
19	0	·4163514	·8558391	1·3465992	1·9292543
	·2121320	·2139828	·2197626	·2302287	·2469416
20	0	·4284077	·8807623	1·3861929	1·9867744
	·2179449	·2198606	·2258433	·2366781	·2539828
21	0	·4401360	·9050057	1·4247026	2·0427101
	·2236068	·2255854	·2317651	·2429578	·2608369
22	0	·4515616	·9286218	1·4622122	2·0971840
	·2291288	·2311687	·2375398	·2490805	·2675179
23	0	·4627064	·9516565	1·4987939	2·1503024
	·2345208	·2366202	·2431779	·2550572	·2740380
24	0	·4735903	·9741508	1·5345139	2·2021616
	·2397916	·2419491	·2486887	·2608980	·2804084
25	0	·4842308	·9961404	1·5694295	2·2528457
	·2449490	·2471633	·2540801	·2666117	·2866387
50	0	·6995857	1·4409868	2·2751863	3·2760792
	·3500000	·3533454	·3637983	·3827476	·4130572
100	0	·9997548	2·0606127	3·2571060	4·6973149
	·4974937	·5023813	·5176589	·5453562	·5896685
400	0	2·0150354	4·1553109	6·5735909	9·4914497
	·9987492	1·0087684	1·0400784	1·0968491	1·1876817

TABLE C—(*continued*).

n	$\rho=\cdot5$	$\rho=\cdot6$	$\rho=\cdot7$	$\rho=\cdot8$	$\rho=\cdot9$
3	·6397035	·8298069	1·0821815	1·4670408	2·2572614
	·0787233	·0836496	·0914099	·1051565	·1375647
4	·8697069	1·1461037	1·5308211	2·1592865	3·6084918
	·0997391	·1080827	·1216223	·1467433	·2112748
5	1·0657049	1·4204694	1·9303003	2·8019830	4·9700548
	·1179621	·1296152	·1488972	·1857778	·2860585
6	1·2384801	1·6646016	2·2906234	3·3941363	6·2758785
	·1342232	·1489755	·1737018	·2219447	·3579595
7	1·3941989	1·8857159	2·6192262	3·9396570	7·4992321
	·1490074	·1666372	·1964454	·2553750	·4253943
8	1·5367713	2·0886726	2·9218412	4·4441908	8·6363301
	·1626318	·1829343	·2174712	·2863637	·4881142
9	1·6688524	2·2769195	3·2029089	4·9133944	9·6932562
	·1753174	·1981116	·2370570	·3152309	·5464383
10	1·7923354	2·4529927	3·4658872	5·3522889	10·6791012
	·1872248	·2123532	·2554247	·3422692	·6008602
11	1·9086231	2·6188112	3·7134918	5·7651162	11·6030258
	·1984751	·2258005	·2727512	·3677294	·6518808
12	2·0191978	2·7758616	3·9478808	6·1553948	12·4732325
	·2092046	·2385646	·2891787	·3918213	·6999496
13	2·1236943	2·9253194	4·1707880	6·5260261	13·2967143
	·2193627	·2507341	·3048225	·4147185	·7454499
14	2·2238984	3·0681290	4·3836241	6·8794630	14·0793562
	·2291249	·2623809	·3197770	·4365653	·7887049
15	2·3200595	3·2050605	4·5875494	7·2175324	14·8260439
	·2385095	·2735636	·3341195	·4574817	·8299826
16	2·4125823	3·3367521	4·7835297	7·5420659	15·5412908
	·2475526	·2843315	·3479156	·4775684	·8695312
17	2·5018385	3·4637416	4·9723756	7·8544126	16·2273352
	·2562879	·2947261	·3612200	·4969104	·9074724
18	2·5881420	3·5864801	5·1547751	8·1557645	16·8882836
	·2647443	·3047823	·3740794	·5155798	·9440329
19	2·6717601	3·7053440	5·3313166	8·4471433	17·5262030
	·2729462	·3145295	·3865338	·5336387	·9793257
20	2·7529232	3·8206677	5·5025071	8·7294265	18·1432348
	·2809148	·3239936	·3986177	·5511403	1·0134685
21	2·8318307	3·9341863	5·6687868	9·0033775	18·7411717
	·2886686	·3333199	·4103611	·5681311	1·0465598
22	2·9086578	4·0418750	5·8305409	9·2696624	19·3216440
	·2962240	·3421658	·4217904	·5846516	1·0786891
23	2·9835558	4·1481734	5·9881082	9·5288659	19·8860017
	·3035949	·3509062	·4329287	·6007373	1·1099306
24	3·0566623	4·2518695	6·1417876	9·7815042	20·4355030
	·3107942	·3594371	·4437967	·6164198	1·1403534
25	3·1280980	4·3532587	6·2918434	10·0281639	20·9711894
	·3178324	·3677825	·4544124	·6317351	1·1700149
50	4·5677713	6·3911451	9·2990780	14·9462808	31·5884211
	·4603212	·5361355	·6677547	·9376711	1·7584334
100	6·5628599	9·2058648	13·4374982	21·6797456	46·0257637
	·6587893	·7696570	·9623213	1·3574820	2·5594824
400	13·2812941	18·6652227	27·3067557	44·1732879	94·0676645
	1·3293798	1·5566854	1·9517326	2·7620803	5·2272309

MISCELLANEA.

I. Tables for estimating the Probability that the Mean of a unique Sample of Observations lies between $-\infty$ and any given Distance of the Mean of the Population from which the Sample is drawn.

By "STUDENT."

In the last number of *Biometrika* Mr Young completes the table given in Vol. x. p. 522 of the standard deviation frequency curves for small samples by working out the cases where the numbers in the sample are as low as two and three.

In the course of his note he writes "The smallest sample considered is that of $n = 4$ but samples of two and three are of occasional occurrence, especially in physical work, and now and again a value of the probable error of an experimental result is deduced from a set of two or of three observations."

Further on he states "it is evident that the probable error determined from a set of three observations is very untrustworthy and that when there are only two observations it is very much worse."

Now in my original paper (*Biometrika*, Vol. VI. p. 1) I stopped at $n = 4$ because I had not realised that anyone would be foolish enough to work with probable errors deduced from a smaller number of observations, but now I too will complete my tables which will I think emphasise the moderation of the second quotation from Mr Young's note.

Generally speaking there are two objects in determining the standard deviation of a set of observations, namely (1) to compare it with the standard deviation of similar sets of observations, and (2) to estimate the accuracy with which the mean of the observations represents the mean of the population from which the sample is drawn.

The former purpose is served by the table which Mr Young was engaged in completing, the latter, which is by far the most common use of the S.D., by the table which I gave in my original paper and which I now propose to complete downwards by including $n = 2$ and $n = 3$ and to extend upwards as far as $n = 30$.

In the tables the probability is given (to four places of decimals) that the mean of a unique sample shall lie between $-\infty$ and a distance z from the mean of the population, z being measured in terms of the S.D. (s) of the sample.

[By unique I mean to say that all the information which we have (or at all events intend to use) about the distribution of the population is given by the sample in question.]

To compare with the last column of the table ($n = 30$) I have given the corresponding probability calculated from the nearest normal curve, namely the one with S.D. $\frac{s}{\sqrt{n-3}}$ (not $\frac{s}{\sqrt{n-1}}$ as is usually given) and this shows I think that for ordinary purposes Sheppard's tables may be used with $n > 30$.

With regard to samples of two it will be seen that odds of 9 : 1 are reached at a little more than three times the S.D., of 99 : 1 at a little more than thirty times, of 999 : 1 at a little more than 300 times, while 9999 : 1 is reached at in or about 3000 times the S.D.!

Perhaps I may be permitted to restate my opinion as to the best way of judging the accuracy of physical or chemical determinations.

After considerable experience I have not encountered any determination which is not influenced by the date on which it is made, from this it follows that a number of determinations of the same thing made on the same day are likely to lie more closely together than if the repetitions had been made on different days.

It also follows that if the probable error is calculated from a number of observations made close together in point of time much of the secular error will be left out and for general use the probable error will be too small.

Where then the materials are sufficiently stable it is well to run a number of determinations on the same material through any series of routine determinations which have to be made, spreading them over the whole period.

Thus if an analyst is determining the percentage of nitrogen in different samples of seed corn and wishes to know the probable error of the determination, i.e. how accurately his figures give the percentage of nitrogen in a bulk of corn.

Let us suppose that he makes ten determinations a day for sixty days and that it is of some real importance to him to get a clear idea of his error; he will do well to get sixty *different* samples from the same bulk of corn and analyse one of these on each of the sixty days; unless I am much mistaken he will have a more modest idea of his infallibility than he had before he compared the sixty results together. He will also, in so far as his repeated sample is representative, get a close approximation to the probable error of a single determination.

In some cases it is not possible to obtain a sufficient bulk of material and then it may be better to determine each result in duplicate, the repetitions being separated as widely as possible in point of time. Then the square root of the mean of the squares of the differences between corresponding pairs gives twice the standard deviation of the average of a pair, and if enough pairs can be taken and the determinations made on different samples this is a better method than the other, as the error of the sampling is better sampled.

In the preparation of the tables a slight mistake was discovered in the second row of the odd numbers in the original table by Mr W. L. Bowie to whom I am indebted for the calculation of the new figures.

$z\,(=x/s)$	$n=2$	$n=3$	$n=4$	$n=5$	$n=6$	$n=7$	$n=8$	$n=9$	$n=10$	$n=11$	$n=12$	$n=13$	$n=14$	$n=15$	$n=16$	$n=17$	$n=18$	$n=19$
·1	·5317	·5498	·5633	·5745	·5841	·5928	·6006	·6079	·6146	·6210	·6269	·6326	·6380	·6432	·6481	·6529	·6575	·6619
·2	·5628	·5981	·6241	·6453	·6634	·6795	·6936	·7066	·7185	·7295	·7397	·7493	·7583	·7668	·7748	·7824	·7896	·7965
·3	·5928	·6437	·6804	·7096	·7340	·7549	·7733	·7896	·8042	·8174	·8294	·8404	·8505	·8598	·8683	·8762	·8836	·8904
·4	·6211	·6857	·7309	·7657	·7940	·8175	·8375	·8547	·8697	·8827	·8942	·9045	·9135	·9217	·9289	·9354	·9413	·9466
·5	·6476	·7236	·7749	·8131	·8428	·8667	·8863	·9025	·9161	·9275	·9373	·9455	·9527	·9588	·9640	·9686	·9725	·9760
·6	·6720	·7573	·8125	·8518	·8813	·9040	·9218	·9360	·9473	·9565	·9640	·9701	·9752	·9793	·9827	·9856	·9879	·9899
·7	·6944	·7867	·8440	·8830	·9109	·9314	·9468	·9585	·9675	·9744	·9798	·9840	·9873	·9900	·9920	·9936	·9949	·9960
·8	·7148	·8123	·8701	·9076	·9332	·9512	·9640	·9733	·9801	·9851	·9888	·9916	·9937	·9952	·9964	·9972	·9979	·9984
·9	·7333	·8345	·8915	·9269	·9498	·9652	·9756	·9828	·9878	·9913	·9938	·9956	·9968	·9977	·9983	·9988	·9991	·9994
1·0	·7500	·8536	·9092	·9419	·9622	·9751	·9834	·9889	·9925	·9949	·9966	·9977	·9984	·9989	·9993	·9995	·9997	·9998
1·1	·7651	·8700	·9236	·9537	·9714	·9821	·9887	·9928	·9954	·9970	·9981	·9988	·9992	·9995	·9997	·9998	·9999	·9999
1·2	·7789	·8841	·9354	·9628	·9782	·9870	·9922	·9953	·9971	·9982	·9989	·9993	·9996	·9997	·9998	·9999		
1·3	·7913	·8963	·9451	·9700	·9832	·9905	·9946	·9969	·9982	·9990	·9994	·9996	·9998	·9999	·9999			
1·4	·8026	·9069	·9531	·9756	·9870	·9930	·9962	·9979	·9989	·9994	·9997	·9998	·9999					
1·5	·8128	·9160	·9598	·9800	·9899	·9948	·9973	·9986	·9993	·9996	·9998	·9999						
1·6	·8222	·9240	·9652	·9836	·9920	·9961	·9981	·9990	·9995	·9997	·9999							
1·7	·8308	·9310	·9699	·9864	·9937	·9970	·9986	·9993	·9997	·9998								
1·8	·8386	·9371	·9737	·9886	·9950	·9977	·9990	·9995	·9998	·9999								
1·9	·8458	·9425	·9770	·9904	·9959	·9983	·9992	·9997	·9999									
2·0	·8524	·9472	·9797	·9919	·9967	·9986	·9994	·9998										
2·1	·8585	·9514	·9821	·9931	·9973	·9989	·9996	·9998										
2·2	·8642	·9552	·9841	·9941	·9978	·9992	·9997	·9999										
2·3	·8695	·9585	·9858	·9950	·9982	·9993	·9998											
2·4	·8743	·9615	·9873	·9957	·9985	·9995	·9998											
2·5	·8789	·9642	·9886	·9963	·9987	·9996	·9998											
2·6	·8831	·9667	·9898	·9967	·9989	·9996	·9999											
2·7	·8871	·9689	·9908	·9972	·9991	·9997												
2·8	·8908	·9709	·9916	·9975	·9992	·9998												
2·9	·8943	·9727	·9924	·9978	·9993	·9998												
3·0	·8976	·9743	·9931	·9981	·9994	·9998												
3·1	·9007	·9759	·9937	·9983	·9995	·9999												
3·2	·9036	·9772	·9942	·9984	·9996													
3·3	·9063	·9785	·9947	·9986	·9996													
3·4	·9089	·9797	·9951	·9988	·9997													
3·5	·9114	·9808	·9955	·9989	·9997													

4·0	·9220	·9851	·9969	·9994	·9998
4·5	·9303	·9881	·9977	·9996	·9998
5·0	·9372	·9903	·9984	·9997	·9999
5·5	·9428	·9919	·9988	·9998	
6·0	·9474	·9932	·9990	·9999	
6·5	·9514	·9942	·9992		
7·0	·9548	·9950	·9994		
7·5	·9578	·9956	·9995		
8·0	·9604	·9961	·9996		
8·5	·9627	·9966	·9996		
9·0	·9648	·9969	·9997		
9·5	·9666	·9973	·9997		
10·0	·9683	·9975	·9998		
15·0	·9788	·9989	·9999		
20·0	·9841	·9994			
25·0	·9873	·9996			
30·0	·9894	·9997			
35·0	·9909	·9998			
40·0	·9920	·9998			
45·0	·9929	·9999			
50·0	·9935				
60·0	·9947				
70·0	·9955				
80·0	·9960				
90·0	·9965				
100·0	·9968				
120·0	·9973				
140·0	·9977				
150·0	·9979				
160·0	·9980				
180·0	·9982				
200·0	·9984				
250·0	·9987				
300·0	·9989				
350·0	·9991				
400·0	·9992				
450·0	·9993				
500·0	·9994				
600·0	·9995				
700·0	·9995				
1000·0	·9997				
1500·0	·9998				
2000·0	·9998				
3000·0	·9999				

$z\left(=\frac{x}{s}\right)$	$n=20$	$n=21$	$n=22$	$n=23$	$n=24$	$n=25$	$n=26$	$n=27$	$n=28$	$n=29$	$n=30$	For comparison $\left(\frac{\sqrt{27}}{\sqrt{2\pi}}\int_{-\infty}^{x} e^{-\frac{27x^2}{2}}dx\right)$
·1	·6662	·6703	·6744	·6783	·6821	·6858	·6894	·6929	·6964	·6997	·7030	·6983
·2	·8030	·8093	·8152	·8209	·8264	·8316	·8367	·8415	·8462	·8506	·8550	·8507
·3	·8967	·9026	·9082	·9133	·9182	·9227	·9270	·9309	·9347	·9383	·9415	·9405
·4	·9513	·9556	·9595	·9630	·9662	·9691	·9717	·9742	·9763	·9784	·9801	·9802
·5	·9789	·9815	·9838	·9858	·9875	·9890	·9903	·9915	·9925	·9934	·9942	·9953
·6	·9915	·9929	·9940	·9950	·9958	·9964	·9970	·9975	·9979	·9982	·9985	·9991
·7	·9967	·9974	·9979	·9984	·9987	·9990	·9992	·9994	·9995	·9996	·9997	·9999
·8	·9988	·9991	·9993	·9995	·9996	·9997	·9998	·9999	·9999	·9999	·9999	
·9	·9995	·9996	·9997	·9998	·9999	·9999	·9999					
1·0	·9999	·9999	·9999	·9999								

II. On the Representation of Statistical Data.

By L. ISSERLIS, D.Sc.

§ 1. In a paper entitled "On the Mathematical Representation of Statistical Data*" Professor Edgeworth gives several examples of the fitting of what he calls the generalized curve of error and some of his recent modifications of it to frequency data. The examples to which he applies his methods are taken, with a single exception, from a paper by the present writer, in which double hypergeometrical series were fitted to frequency distributions in two variables†. Professor Edgeworth describes these data as "*well suited to test and illustrate methods of representing frequency distributions.*" Judged by the usual criterion for the testing of goodness of fit these examples indicate that Professor Edgeworth's curves are decidedly unsatisfactory, but he maintains that the fault lies in the criterion and not in the curves. Professor Edgeworth proposes therefore a new criterion for the testing of the goodness of fit of theory to observation, viz. the magnitude of the sum $S(e^2/U)$, where U is the ratio of the frequency in any category of the data to the total frequency (called by Professor Edgeworth the relative frequency) and e is the difference between this and the theoretical relative frequency. He adds erroneously that this is Professor Pearson's χ^2 divided by the total frequency N. To quote from Professor Edgeworth's paper (p. 461) "His (i.e. Professor Pearson's) χ^2 being, in our notation, equal to $S(N^2e^2)/S(NU)$, where N is the total number of observations, is N times as great as our criterion $S(e^2/U)$." As a matter of fact Professor Pearson's χ^2 is equal to $S\{(m'-m)^2/m'\}$ where m' is the *theoretical* and m the observed frequency, and in Professor Edgeworth's notation this would be $NS(e^2/u)$ where u is the *theoretical* relative frequency. The fact that the denominator U employed by Professor Edgeworth is the *observed* relative frequency must make the test nugatory in practice, for $S(e^2/U)$ will be infinite whenever the data contain one category with zero frequency. Very little difference results in Professor Edgeworth's examples when the U's are replaced by u's in the criterion proposed by him, but the later part of his paper claims to give methods of curve fitting which‡ "not only do or may give better values for the coefficients than the use of moments, but also *must*§ give better results than moments or any other process." Professor Edgeworth attempts in the section entitled "some new constructions" to achieve this highly desirable end by, as he says, minimising the Pearsonian criterion χ^2. Actually he minimises $S(e^2/U)$, a very much easier thing to do since the denominators are constant, but leading to equations which are altogether irrelevant.

Professor Edgeworth's proposed criterion is an absolute one, independent of the number of categories. The value $S(e^2/U)$ is usually small and apparently we are to judge of the goodness of fit by the number of zeroes between the decimal point and the first significant figure.

In what follows we fit Pearsonian frequency curves of the appropriate type to the examples used by Professor Edgeworth. In addition to calculating χ^2 and the corresponding value of P for each, we give also the values of $S(e^2/U)$ and $S(e^2/u)$. All these are compared with the corresponding values for the curves fitted by Professor Edgeworth‖. It will appear that Professor Edgeworth's curves are a poorer fit than the Pearsonian types not only when judged by the legitimate criterion but even according to the criterion proposed by Professor Edgeworth, and this in spite of the fact that he does not as a rule attempt to fit his curve to the whole of each distribution but confines himself to the central compartments.

* *Journal of the Royal Statistical Society*, Vol. LXXIX. Part IV. (July, 1916).

† *Phil. Mag.* September, 1914.

‡ *Loc. cit.* p. 476.

§ Professor Edgeworth's italics.

‖ So far as that was possible. Several of Professor Edgeworth's calculations in the later sections of the paper are not finished, and some of the arithmetic would have to be rectified before completing the calculations.

§ 2. EXAMPLE I. *Distribution of 25,000 Deals at Whist according to the Number of Trumps held by the First Hand.*

TABLE I.

Number of trumps	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	Total
Frequency ...	215	1724	5262	7440	6371	2950	852	166	20	25000
Relative frequency	·00860	·06896	·21048	·29760*	·25484	·11800	·03408	·00664	·00080	1·00000

We quote from the *Phil. Mag.* paper previously referred to the following values: Mean at 3·24944 trumps, moments about the mean $\mu_2 = 1{\cdot}66130$, $\mu_3 = {\cdot}39004$, also $\beta_1 = {\cdot}03333$, $\beta_2 = 2{\cdot}93469$. These values lead to the Type I curve

$$y = 7596{\cdot}005\left(1 + \frac{x}{6{\cdot}52180}\right)^{16{\cdot}21927}\left(1 - \frac{x}{12{\cdot}76682}\right)^{31{\cdot}75022}$$

with origin at the mode (= 3·12682 trumps) represented by the continuous line in Fig. 1.

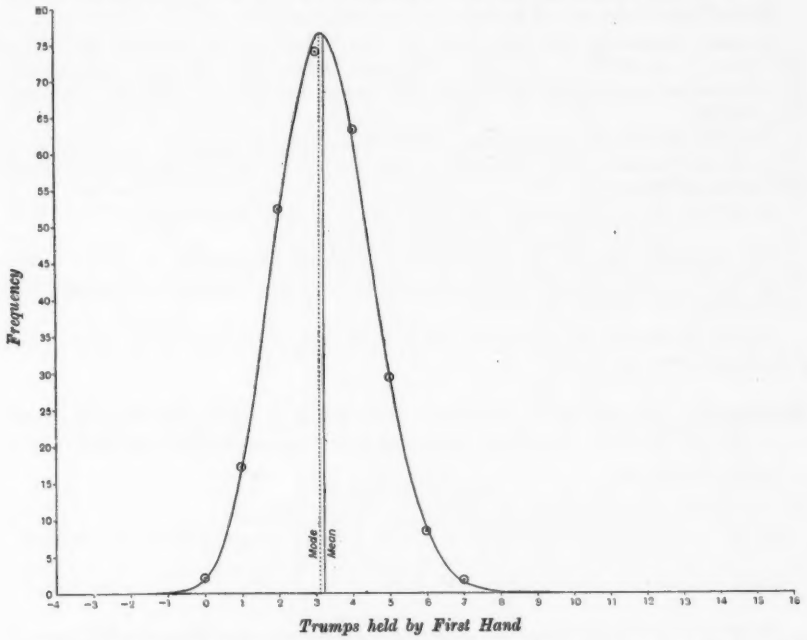


FIG. 1. ⊙⊙⊙ Distribution of 25,000 deals at Whist according to the number of Trumps held by the First Hand according to theory.

Continuous Line: Type I Frequency Curve

$$y = 7596{\cdot}005\left(1 + \frac{x}{6{\cdot}52180}\right)^{16{\cdot}21927}\left(1 - \frac{x}{12{\cdot}76682}\right)^{31{\cdot}75022}.$$

* ·29776 in Prof. Edgeworth's paper is clearly a misprint.

The following table gives the theoretical frequencies of this curve compared with the observed frequencies and the theoretical frequencies for the two curves fitted by Professor Edgeworth. These last being obtained by multiplying the values he gives of the theoretical relative frequencies by 25,000.

TABLE II.

Number of trumps	*−1*	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	Totals
Observed frequency	—	215	1724	5262	7440	6371	2950	852	166	20	—	—	25000
Type I	4·91	202·85	1698·32	5201·23	7643·49	6218·30	2993·16	871·65	152·89	15·34	·85	·02	25003
		Sum = 207·76									Sum = 16·21		
Prof. Edgeworth's 1st curve, p. 461	—	—	—	5120	7338	6128	3028	—	—	—	—	—	—
Prof. Edgeworth's 2nd curve, p. 467	—	258	1778	5093	7420	6183	3098	965	208	—	—	—	25003

For the Type I curve $\chi^2 = 13{\cdot}60$ while $n' = 9$ so that $P = {\cdot}0938$.

Professor Edgeworth's first curve gives $\chi^2 = 17{\cdot}48$, $n' = 4$ and $P = {\cdot}000574$*. His second curve gives $\chi^2 = 41{\cdot}55$ for $n' = 8$ so that P is less than ·000001. If in the second curve we take the four central compartments only (i.e. 2 to 5 trumps) we have $\chi^2 = 19{\cdot}48$, $n' = 4$ so that $P = {\cdot}000222$.

Judged by the usual criterion then, both of Professor Edgeworth's curves are a very much poorer fit than Pearson's Type I. If we calculate the value of the criterion proposed by Professor Edgeworth we find that

$S(e^2/U)$ is ·000814 for Professor Edgeworth's first curve (four compartments),
·00181 for eight compartments of his second curve,
and ·00077 for the four central compartments of the second curve.

These values of $S(e^2/U)$ may be compared with ·000544 for nine compartments or ·000420 for four compartments for Pearson's Type I.

Professor Edgeworth says (p. 467) of this example that "the correspondence between fact and theory is very satisfactory."

EXAMPLE II. *The theoretical Frequency Distribution of black Balls in* 210 *Draws of four Balls out of a Bag containing four white and six black Balls.*

The frequencies are

TABLE III.

0	*1*	*2*	*3*	*4*	Total
1	24	90	80	15	210

The mean is at 2·4 black balls, the moments about the mean are $\mu_2 = {\cdot}64$, $\mu_3 = -{\cdot}032$, $\mu_4 = 1\frac{1}{7}$ so that $\beta_1 = {\cdot}00390625$, $\beta_2 = 2{\cdot}747768$. The corresponding Pearsonian frequency curve is of Type II,

$$y = 101{\cdot}06905\left[1 - \frac{x^2}{(3{\cdot}7341772)^2}\right]^{9{\cdot}3938124}$$

represented by the continuous line in Fig. 2. The origin is at mode = mean = 2·4.

* Professor Edgeworth calls this $\chi^2 = 40$, $n' = 6$ but only states the calculated (relative) frequencies for four compartments.

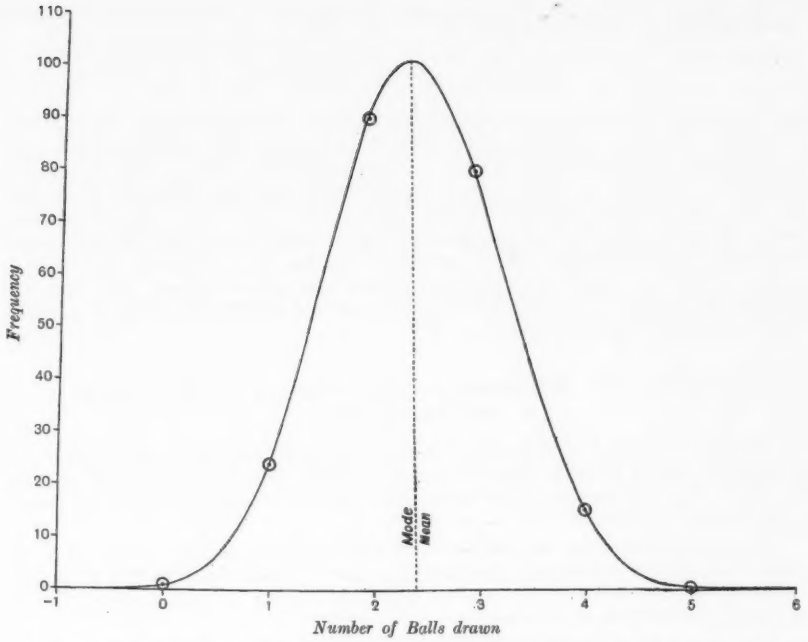


FIG. 2. ⊙⊙⊙ Theoretical Distribution of Black Balls in 210 draws of 4 balls out of a bag containing 4 white and 6 black balls, i.e. terms of the hypergeometrical series $F(-4, -6, 1, 1)$.

Continuous Line: Type II Frequency Curve

$$y = 101{\cdot}06905\left[1 - \left(\frac{x}{3{\cdot}734177}\right)^2\right]^{9{\cdot}393512}.$$

The table below gives the theoretical frequencies deduced from this equation and the values given by Professor Edgeworth on p. 471 of his paper*.

TABLE IV.

Number of Black Balls drawn	*0*	*1*	*2*	*3*	*4*	Totals
Data	1	24	90	80	15	210
	Sum = 25					
Type II	·677	24·322	90·669	79·051	15·036	209·755
	Sum = 24·999					
Professor Edgeworth's curve, p. 471	28·39		86·71	76·56	28·44	220·10

* Professor Edgeworth's are relative frequencies. These have been multiplied by 210 to obtain the entries in the table.

The value of χ^2 for the Type II curve is only ·016 while $n' = 4$. This value is so small as to be outside Elderton's table, so we put

$$P = \sqrt{\frac{2}{\pi}} \int_{\chi}^{\infty} e^{-\frac{1}{2}x^2} dx + \sqrt{\frac{2}{\pi}} e^{-\frac{1}{2}\chi^2} \chi,$$

and from Sheppard's table find the first term to be ·89894 while the second is ·10052 so that $P = ·99946$. The fit is practically perfect. This is not surprising since we have fitted a curve which is known to be the so-called "parallel" to the hypergeometrical series to a hypergeometrical distribution. The value of χ^2 for Professor Edgeworth's curve is 7·035 which with $n' = 4$ gives $P = ·071$. The sum $S(e^2/U)$ is ·000077 for the Type II curve and ·061* for Professor Edgeworth's curve. He says (p. 470) that "the calculated frequencies correspond fairly well with the observed frequencies." The divergence between the total for the data (210) and for the calculated frequencies (220·1) is extraordinarily great and suggests that some errors may have crept into Professor Edgeworth's arithmetic. The values of $S(e^2/u)$ are ·000077 for the Type II curve and ·0335 for Professor Edgeworth's curve.

Example III. *Distribution according to ages, of the Marriages of* 235,252 *Spinsters.*

This example is described by Professor Edgeworth as one of "considerable abnormality," and he states (p. 462) "I should be considerably surprised if the Pearsonian types would stand the Pearsonian criterion in the case of Dr Isserlis' second example which consists of the distribution of 235,252 ages at marriage."

The answer is that at any rate they stand the test much better than the curve fitted to this example by Professor Edgeworth. That the fit is a poor one is probably due not so much to the size of the total frequency (as Professor Edgeworth suggests) but to heterogeneity of the material†, due to misstatement of age.

The observed frequencies are as follows:

TABLE V.

Age	*15—*	*20—*	*25—*	*30—*	*35—*	*40—*	*45—*	*50—*	*55—*	*60—*	*65—*	*70—*	Total
Frequency	17546	118542	70411	20241	5873	1706	636	171	64	28	23	11	235252

Again quoting from the *Phil. Mag.* (*loc. cit.*, p. 385): with arbitrary origin at 22·5 years and unit 5 years, the mean is at ·5227798, the moments are $\mu_2 = ·8294195$, $\mu_3 = 1·2482896$, $\mu_4 = 5·9016221$ whence $\beta_1 = 2·730913$, $\beta_2 = 8·578766$‡. These values of β_1, β_2 indicate a curve of Type VI, but the criterion

$$\kappa = \beta_1 (\beta_2 + 3)^2/4 (4\beta_2 - 3\beta_1) (2\beta_2 - 3\beta_1 - 6) = 1·151975$$

is so nearly unity, that (having regard to the large values of β_1, β_2) we may expect the transition curve of Type V to give nearly as good a fit.

The curve of Type VI is

$$y = (4·29787)\, 10^{14}\, (x - 2·305660)^{6·599764}\, x^{-13·410607}$$

with origin at 4·655444 years, mode at 22·625624 years, mean at 25·113899 years and x measured in 5 year units.

* Not ·07 (Prof. Edgeworth's value on p. 470).

† On this point cf. W. Palin Elderton, *Frequency Curves and Correlation*, pp. 142–3.

‡ The *Phil. Mag.* value, $\beta_2 = 8·77876$ is wrong (though μ_2, μ_3, μ_4 are correct). Professor Edgeworth has used the wrong value, but the error is not enough seriously to influence his figures.

The curve of Type V is $y = (1{\cdot}43044)\ 10^{13}\ x^{-10{\cdot}7294715}\ e^{-\frac{22{\cdot}1029363}{x}}$.

Here also x is in 5 year units, the origin is at 12·453948 years and the mode at 22·754053 years.

The two curves are shown in Fig. 3.

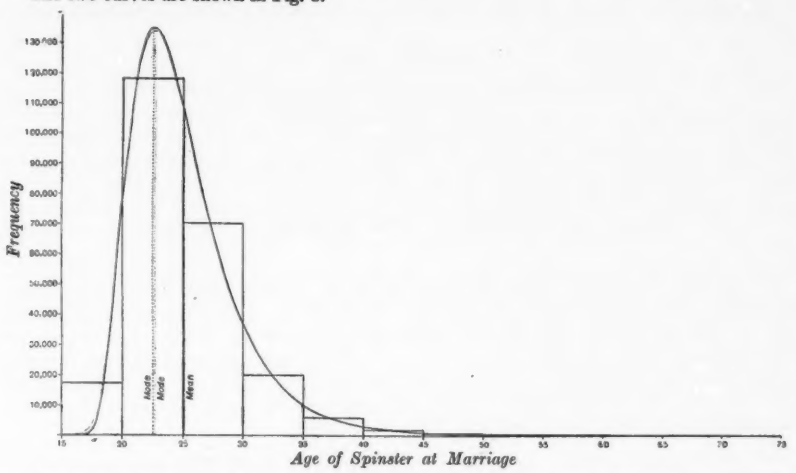


FIG. 3. Distribution of Ages at Marriage of 235,252 Spinsters. Actual Frequencies represented by the histogram.

Continuous Curve: Type VI Frequency Curve

$$y = (4{\cdot}29787)\ 10^{14}\ \frac{(x - 2{\cdot}305660)^{6{\cdot}5997864}}{x^{18{\cdot}4416607}}.$$

Dotted Curve: Type V Frequency Curve

$$y = (1{\cdot}43044)\ 10^{13}\ x^{-10{\cdot}7291723}\ e^{-\frac{22{\cdot}1029363}{x}}.$$

The observed and calculated frequencies are given in the table below.

TABLE VI.

Age at Marriage of Spinsters.

Age	Observed frequency	Type VI	Type V	Prof. Edgeworth's* curve, p. 469
15—	17546	15969†	16448‡	14633
20—	118542	120458	120061	123696
25—	70411	69289	69508	68811
30—	20241	21009	20907	19596
35—	5873	5896	5770	5740
40—	1706	1732	1692	
45—	636	582	544	
50—	171	191	191	
55—	64	71	73	2752
60—	28	28	30	
65—	23	12	13	
70—	11	16§	13§	
	Sum = 2639	Sum = 2632	Sum = 2556	
Totals	235252	235253	235250	235228

* I.e. Professor Edgeworth's relative theoretical frequencies multiplied by 235252.

† 16·184 years to 20 years. ‡ 12·454 years to 20 years. § All beyond 70 years.

It is worth noting that with the exception of one age group (30—35) the theoretical frequencies corresponding to Professor Edgeworth's curve are consistently worse than both the Type V and Type VI frequencies.

The values of χ^2, $S(e^2/U)$, and $S(e^2/u)$ for the three curves are given by the following table:

TABLE VII.

	χ^2	$S(e^2/U)$	$S(e^2/u)$
Type V	129	·00053	·00055
Type VI	232	·00090	·00099
Prof. Edgeworth's curve	868	·00366	·00369

Neither Type V nor Type VI fits the data well, but all the criteria agree in making Professor Edgeworth's curve a much poorer fit than either of the others. It should be observed that in order to make comparison with Professor Edgeworth's curve possible we have followed him in grouping all ages above 40 together. This gives a fictitious improvement to the Type V curve, for Type VI which depends on the first four moments will fit the "tail" of the experience better than Type V whose constants depend on the first three moments only. The value of μ_4 is of course heavily influenced by the marriages at the higher ages.

The source of heterogeneity in the spinster curve is misstatement (false or in ignorance) of age. I am indebted to Professor Pearson for the remark that Table V shows a lumping up of frequency before the decades. If we compare Type VI against the observed, we find a redundancy of women just below 30, i.e. at 25, and this is repeated at 45. Again the group 15—20 is increased by the minors who misstated their age as over 15. Professor Pearson informs me that these points have come up for consideration in the treatment of very ample statistics not only English but Italian, and in both cases the males give better results than the females.

We may attempt to circumvent the women who object to entering a new decade by grouping in ten year periods round the decades. The following table shows that the removal of this source of heterogeneity at once renders Type VI a very good fit, the transition curve Type V a fair fit, but leaves Professor Edgeworth's curve a very poor fit.

TABLE VIII.

Age	Observed frequency	Type VI	Type V	Prof. Edgeworth's curve
15—	136088	136427	136509	138329
25—	90652	90298	90415	88407
35—	7579	7628	7462	
45—	807	773	735	8492
55—	92 Sum	99 Sum	103 Sum	
65—	34 = 126	28 = 127	26 = 129	
Totals	235252	235253	235250	235228

We now have $\chi^2 = 4{\cdot}56$ when $n' = 5$ for the Type VI curve so that $P = {\cdot}34$ indicating quite a good fit. For Type V the value of χ^2 is 11·01 with $n' = 5$ giving $P = {\cdot}027$, while for Professor Edgeworth's curve χ^2 is 96·31 with $n' = 3$ so that P is still negligible.

§ 3. Professor Edgeworth has on several occasions advocated the value of his generalized frequency curve, and endeavoured to illustrate its numerical advantages. On the present occasion he has introduced what appears to be an erroneous formula for testing its "goodness of fit." In his paper he gives no theoretical discussion of the test. It would be well if Professor Edgeworth tried on some future occasion to give a demonstration of its validity. Any such attempt would have to account for the departure from Bernoulli's law that accuracy varies as the square root of the number of observations. According to Professor Edgeworth's test results obtained from 100 observations and from 1,000,000 would be equally accurate provided the relative frequencies were the same*! However taking him on his own ground we find his curves give a very poor fit compared with Pearson's well-known types, and offer no easy systematical methods of treating frequency. He escapes what is the real hard work of curve fitting by adopting the higher moments calculated by the biometricians and then appears to say how very much shorter his methods are! We are prepared on any occasion to race him in fitting a frequency curve *ab initio* and getting a better fit as a result.

Added April 12th, 1917. Professor Edgeworth in reply to a letter in which I suggested that there might be an error in his numerical values quoted in my Table IV, has replied that owing to a clerical error the frequency in the last column is wrong. On using his amended relative frequency, that entry becomes 18·35 instead of 28·44. With this alteration χ^2 becomes 1·297 instead of 7·035, so that the corresponding value of P is ·733. This of course denotes a good fit, but one which is still very inferior to the Pearsonian Type II curve for which $P = ·999$.

III. Relation of the Mode, Median and Mean in Frequency Curves.

By ARTHUR T. DOODSON, M.Sc.

§ 1. It is well known that in frequency curves of a moderate degree of asymmetry the distance from the mode to the median is approximately two-thirds of the distance from the mode to the mean. So far as the author knows there has not been published any investigation of this property except in the case of one type of curve where

$$y = y_0 x^p e^{-x}.$$

Professor Karl Pearson, in his memoir on "Skew Variation in Homogeneous Material" (*Phil. Trans.* 1895), remarks on this property of the curve and he gives an expression for the ratio of the two distances in the form

$$c = ·6691 + ·0094/p \quad \text{.....(1).}$$

This was obtained from a few particular cases by the method of least squares.

§ 2. Let $y = y_0 \phi(x)$ represent a frequency curve which has a maximum at $x = 0$ and which is zero at $x = -a_1$ and at $x = a_2$. As a rule there is only one maximum in frequency curves of this type. On these assumptions Laplace has given a method of approximating to the definite integral, the limits of integration lying between $x = -a_1$ and $x = a_2$. Following Laplace, we assume

$$y = y_0 \phi(x) = y_0 e^{-t^2} \quad \text{.....(2),}$$

where y_0 is the maximum ordinate, or the mode. Since x vanishes with t we may assume

$$x = B_1 t + B_2 t^2 + B_3 t^3 + \dots \quad \text{.....(3).}$$

* Cf. on the other hand Pearson's χ^2 test. Let there be two series of observations with populations N_1, N_2 and same relative frequency leading to $S(e^2/u) = \chi_0^2$. The two values of χ^2 would be $\chi_1^2 = N_1 \chi_0^2$, $\chi_2^2 = N_2 \chi_0^2$ so that the probabilities would be proportional to $e^{\frac{-\frac{1}{2}\chi_0^2}{(1/\sqrt{N_1})^2}}$ and $e^{\frac{-\frac{1}{2}\chi_0^2}{(1/\sqrt{N_2})^2}}$, comparing with standard deviations of form $1/\sqrt{N_1}$ and $1/\sqrt{N_2}$.

Then, taken between appropriate limits,

$$\int y\,dx = \int y_0 e^{-t^2} \cdot \frac{dx}{dt} \cdot dt = \int y_0 e^{-t^2} (B_1 + 2B_2 t + 3B_3 t^2 + \ldots)\,dt \quad \ldots\ldots\ldots\ldots(4).$$

This method is most useful where the range of t is either $-\infty$ to $+\infty$ or 0 to $+\infty$. The first case gives the "whole" area N; the second gives N_m, the area from the mode to the upper limit of x. Therefore

$$N = \int_{-\infty}^{+\infty} y_0 e^{-t^2} (B_1 + 3B_3 t^2 + \ldots)\,dt = y_0 \sqrt{\pi}\,(B_1 + \tfrac{3}{2}B_3 + \ldots) \quad \ldots\ldots\ldots\ldots(5),$$

$$N_m = \tfrac{1}{2}N + \int_0^{\infty} y_0 e^{-t^2} (2B_2 t + 4B_4 t^3 + \ldots)\,dt = \tfrac{1}{2}N + y_0 (B_2 + 2!\,B_4 + 3!\,B_6 + \ldots)\ldots\ldots(6).$$

Hence the area from the mode to the median is

$$y_0 (B_2 + 2!\,B_4 + 3!\,B_6 + \ldots) \quad \ldots\ldots\ldots\ldots(7).$$

The evaluation of $B_1, B_2, \ldots$ we shall perform by means of the method of indeterminate coefficients, using (3) and

$$\frac{dx}{dt} \cdot \frac{d\phi}{dx} + 2t\phi = 0 \quad \ldots\ldots\ldots\ldots(8)$$

which is obtained by logarithmic differentiation of (2) with respect to t. De Morgan* gives the values of the first five coefficients in terms of the differential coefficients at the mode of $\log \phi(x)$. It may be shown that when $\phi(x)$ contains high exponents or a large number of factors the coefficients $B_1, B_2, B_3, \ldots$ are of decreasing magnitude and the series (5) and (7) are convergent enough for use. This is generally the case with frequency curves. When the skewness is small the coefficients $B_2, B_4, \ldots$ must be small; in this case, then, if d be the abscissa of the median we have the area from the mode to the median approximately equal to $y_0 d$, and usually we may neglect $B_4, B_6, \ldots$ in comparison with B_2. Hence approximately

$$d = B_2 \quad \ldots\ldots\ldots\ldots(9).$$

If we let D be the distance of the mean from the mode we have

$$D = \frac{1}{N}\int_{-a_1}^{a_2} xy\,dx = \frac{1}{N}\int_{-\infty}^{+\infty} y_0 e^{-t^2} \tfrac{1}{2} (2C_2 t + 3C_3 t^2 + \ldots)\,dt \ldots\ldots\ldots\ldots(10),$$

where C_r is the coefficient of t^r in the expansion of x^2 in powers of t. Then from (5) we have

$$D = \frac{y_0}{N}\sqrt{\pi}\,(\tfrac{3}{4}C_3 + \ldots) = \frac{\tfrac{3}{2}B_1 B_2 + \ldots}{B_1 + \ldots} \quad \ldots\ldots\ldots\ldots(11).$$

Therefore to a first approximation $D = \tfrac{3}{2}B_2 = \tfrac{3}{2}d$ $\ldots\ldots\ldots\ldots(12).$

This is the relation that has been noticed in practical statistical work and it holds under the conditions stated.

§ 3. The relation just found is quite general provided that the frequency curves are moderately asymmetrical. It would, of course, be possible to give general formulae for the more accurate representation of the relation between the distances of the mean and median from the mode in the very general type of curve already used. But in practice nearly all the types of frequency curves are included in Professor Pearson's system and it is for these curves that we shall now obtain a closer approximation to the true value of d/D. In the memoir already quoted Professor Pearson takes the differential equation of frequency curves in the form

$$\frac{1}{y}\frac{dy}{dx} = \frac{x}{a_0 + a_1 x + a_2 x^2} \quad \ldots\ldots\ldots\ldots(13),$$

the origin of x being at the mode.

If we write $y = e^{-t^2}$ we obtain, as in (8),

$$\frac{dx^2}{dt} + 4ta_2 x + 4t(a_0 + a_1 x) = 0 \quad \ldots\ldots\ldots\ldots(14),$$

and writing

$$x^2 = C_2 t^2 + C_3 t^3 + \ldots \quad \ldots\ldots\ldots\ldots(15),$$

* *Differential and Integral Calculus*, p. 602.

we have the following equations for the determination of B_1, B_2, ...

$$\left.\begin{aligned} C_2 + 2a_0 &= 0 & C_2 &= B_1^2 \\ 3C_3 + 4a_1B_1 &= 0 & C_3 &= 2B_1B_2 \\ 4C_4 + 4a_2C_2 + 4a_1B_2 &= 0 & C_4 &= 2B_1B_3 + B_2^2 \\ 5C_5 + 4a_2C_3 + 4a_1B_3 &= 0 & C_5 &= 2B_1B_4 + 2B_2B_3 \\ \cdots\cdots\cdots & & \cdots\cdots\cdots & \end{aligned}\right\} \quad \cdots\cdots\cdots\cdots\cdots\cdots(16).$$

The solution of these equations gives the following values of B_1, B_2, ...

$$\left.\begin{aligned} B_1^2 &= -2a_0 & B_2 &= -\frac{2}{3}a_1 \\ B_3 &= \frac{1}{B_1}\left(\frac{1}{9}a_0^2 + a_0a_2\right) & B_4 &= -\frac{2}{135}\frac{a_1^3}{a_0} + \frac{2}{5}a_1a_2 \\ B_5 &= -\frac{1}{B_1}\left(\frac{1}{540}\frac{a_1^4}{a_0} + \frac{a_1^2a_2}{30} + \frac{5}{12}a_0a_2^2\right) & B_6 &= -\frac{4}{8505}\frac{a_1^5}{a_0^2} + \frac{8}{945}\frac{a_1^3a_2}{a_0} - \frac{44}{315}a_1a_2^2 \\ B_7 &= -\frac{1}{B_1}\left(\frac{139}{340200}\frac{a_1^6}{a_0^2} - \frac{53}{12600}\frac{a_1^4a_2}{a_0} + \frac{a_1^2a_2^2}{4200} - \frac{a_0a_2^3}{8}\right) & B_8 &= \frac{2}{25515}\frac{a_1^7}{a_0^3} - \frac{2}{2835}\frac{a_1^5a_2}{a_0^2} + \frac{2}{2835}\frac{a_1^3a_2^2}{a_0} + \frac{2}{63}a_1a_2^3 \\ \cdots\cdots\cdots & & \cdots\cdots\cdots & \end{aligned}\right\}$$

$$\cdots\cdots\cdots\cdots\cdots\cdots(17).$$

The area from the mode to the median is then

$$y_0\left\{-a_1\left(\frac{2}{3} - \frac{4}{5}a_2 + \frac{88}{105}a_2^2 - \frac{16}{21}a_2^3 + \ldots\right) - \frac{a_1^3}{a_0}\left(\frac{4}{135} - \frac{16}{315}a_2 - \frac{16}{945}a_2^2 + \ldots\right)\right.$$
$$\left. - \frac{a_1^5}{a_0^2}\left(\frac{8}{2835} + \frac{16}{945}a_2 + \ldots\right) + \frac{a_1^7}{a_0^3}\left(\frac{16}{8505} + \ldots\right) + \ldots\right\} \quad \cdots\cdots\cdots(18).$$

§ 4. Now this area can be found in another way in terms of d, the distance from the mode to the median, by assuming that $\phi(x)$ can be expanded in powers of x by Maclaurin's Theorem. Professor Pearson* has shown that a high order parabola does not adequately fit these curves throughout the range, but if we assume that the skewness is small and therefore d small, we may use Maclaurin's expansion legitimately within the range $x = 0$ to $x = d$. Since $\frac{d\phi}{dx}$ is zero at the mode we have

$$y = y_0(1 + A_2x^2 + A_3x^3 + \ldots) \quad \cdots\cdots\cdots\cdots\cdots\cdots(19),$$

and substituting in $\int_0^d y\,dx$ we have the required area equal to

$$y_0\left(d + \frac{A_2}{3}d^3 + \frac{A_3}{4}d^4 + \ldots\right) \quad \cdots\cdots\cdots\cdots\cdots\cdots(20).$$

The values of the coefficients A_2, A_3, ... may be obtained by using the differential equation (13) and the expansion (19); whence we obtain

$$A_s = (s+2)A_{s+2}a_0 + (s+1)A_{s+1}a_1 + sA_sa_2,$$

and therefore $A_0 = \frac{1}{2a_0}$, $\quad A_3 = -\frac{a_1}{3a_0^2}$, $\quad A_4 = \frac{a_1^2}{4a_0^3} + \frac{1 - 2a_2}{8a_0^2}$, $\quad A_5 = -\frac{a_1}{6a_0^3} + \ldots.$

Thus the area required is

$$y_0\left\{d + \frac{d^3}{6a_0} - \frac{d^4a_1}{12a_0^2} + \frac{d^5(1 - 2a_2)}{40a_0^2} + \frac{d^5a_1^2}{20a_0^3} - \frac{d^6a_1}{36a_0^3} + \ldots\right\} \quad \cdots\cdots\cdots(21)$$

This expression is in descending powers of a_0 and so is the one obtained in (18). Hence we may assume

$$d = d_0 + \frac{d_1}{a_0} + \frac{d_2}{a_0^2} + \frac{d_3}{a_0^3} + \ldots \quad \cdots\cdots\cdots\cdots\cdots\cdots(22),$$

* *Biometrika*, Vol. II. p. 19.

and substituting for d in (21) we may then equate to (18). After considerable reduction, we have, to the approximation taken throughout the course of the work,

$$\left.\begin{aligned} d_0 &= -a_1\left(\frac{2}{3} - \frac{4}{5}a_2 + \frac{88}{105}a_2^2 - \frac{16}{21}a_2^3 + \ldots\right) & d_2 &= a_1^5\left(\frac{64}{5103} - \frac{1184}{14175}a_2 + \ldots\right) \\ d_1 &= a_1^3\left(\frac{8}{405} - \frac{8}{63}a_2 + \frac{656}{1575}a_2^2 + \ldots\right) & d_3 &= a_1^7\left(\frac{21688}{3444525} + \ldots\right) \end{aligned}\right\} \ldots(23).$$

§ 5. We have assumed that the skewness is small; this is so if a_1 be small, and as the coefficient of a_0^{-3} is approximately $a_1^7/170$ it will be seen that we have a fairly rapidly convergent series for the value of d expressed in terms of the coefficients of the differential equation. We now proceed to transform the series so as to obtain the value of d/D in terms of the skewness.

It is easily shown from the differential equation that

$$\left.\begin{aligned} a_1 &= -D(1 + 2a_2) \\ a_0 &= -\mu_2(1 + 3a_2) + D^2(1 + a_2) \end{aligned}\right\} \quad \ldots\ldots(24),$$

where μ_2 is the second moment coefficient about the mean.

Hence
$$\frac{a_1^2}{a_0} = -\frac{D^2}{\mu_2}\cdot\frac{(1 + 2a_2)^2}{1 + 3a_2}\cdot\left(1 - \frac{D^2}{\mu_2}\cdot\frac{1 + a_2}{1 + 3a_2}\right)^{-1} \ldots\ldots(25).$$

Now the differential equation is obtained on the assumption that $\frac{1}{y}\frac{dy}{dx} = \frac{x}{f(x)}$ and that $f(x)$ is represented for all practical purposes by $a_0 + a_1x + a_2x^2$; this implies that a_3, a_4, ... of the complete expansion are negligibly small and usually a_2 is small also. If we restrict a_2 and $\frac{D^2}{\mu_2}$ (the square of the skewness) to the cases where they are small we may expand by the binomial theorem all the quantities involved in (22), and after some reduction we obtain

$$\frac{d}{D} = \left(\frac{2}{3} + \frac{8}{15}a_2 - \frac{16}{21}a_2^2 + \frac{32}{35}a_2^3 - \ldots\right) + \left(\frac{8}{405} - \frac{64}{945}a_2 + \frac{64}{675}a_2^2 + \ldots\right)(sk.)^2 + \left(\frac{184}{25515} - \frac{9424}{127575}a_2\right)(sk.)^4 + \frac{1328}{3444525}(sk.)^6 + \ldots \ldots\ldots\ldots(26),$$

where $(sk.)$ = skewness.

The values of the coefficients of the successive powers of the skewness are given in the following table:

$(sk.)^0$	$(sk.)^2$	$(sk.)^4$	$(sk.)^6$	
·66666667	·01975309	·00721144	·00038554	—
·53333333	− ·06772486	− ·07387027	—	a_2
− ·76190476	·09481481	—	—	a_2^2
·91428571	—	—	—	a_2^3

§ 6. The types of curves for which the value of d/D is given by (26) are given below* with the values of a_2:

Type I. $y = y_0\left(1 + \frac{x}{a_1}\right)^{m_1}\left(1 - \frac{x}{a_2}\right)^{m_2}$, $a_2 = \frac{1}{m_1 + m_2}$.

Type III. $y = y_0e^{-\gamma x}\left(1 + \frac{x}{a}\right)^{\gamma a}$, $a_2 = 0$.

Type IV. $y = \frac{y_0}{\left(1 + \frac{x^2}{a^2}\right)^m}e^{-\gamma\tan^{-1}\frac{x}{a}}$, $a_2 = -\frac{1}{2m}$.

Type V. $y = y_0x^{-p}e^{-\gamma/x}$, $a_2 = -\frac{1}{p}$.

Type VI. $y = y_0(x - a)^{m_1}x^{-m_2}$, $a_2 = \frac{1}{m_1 - m_2}$.

* These are not in all cases referred to the mode as the origin of x.

It is very doubtful whether the series can be simplified any further and the question of convergency is a very difficult one, for no simple law can be given for any of the coefficients involved. The series has been tested with curves of Types I and III and the results are tabled below:

Type	a_2	$(sk.)^2$	d/D from formula	d/D (correct)	Error
I	0·1	·1733333	·715706	·715702	+ ·000004
	0·1	·4160000	·719087	·719048	+ ·000039
	0·05	·2582456	·696072	·696072	·000000
	0·05	·4657500	·700078	·700181	− ·000103
III	0	0·1	·66871448	·66871460	− ·00000012
	0	0·2	·670909	·670909	·000000
	0	0·5	·678394	·678347	+ ·000047
	0	1·0	·69402	·69315	+ ·00087

These show that the formula gives very good results even for high values of the skewness. It will be noted that in the case of Type III curves we have quite good results even when the skewness is unity. If the equation of Type III be taken in the form

$$y = y_0 e^{-x}\left(1+\frac{x}{p}\right)^p$$

then the square of the skewness is $\frac{1}{p+1}$ and when the skewness is unity p is zero. But the value of d as given by (22) and (23) is

$$d_3 - \frac{d_1}{p} + \frac{d_2}{p^2} - \frac{d_3}{p^3} + \ldots,$$

and this formula is of no great value if p be small. The processes of § 5 give

$$d = d_0' + \frac{d_1'}{p+1} + \frac{d_2'}{(p+1)^2} + \frac{d_3'}{(p+1)^3} + \ldots$$

by what is practically Montfort's Theorem, and the transformed series is simpler and of more value than the untransformed series.

The formula given in § 3 for the area from the mode to the median has also been tested and gives results similar to those for the ratio of d to D. This may be useful if the area on either side of the mode be required.

In conclusion I tender my thanks to Professor Pearson for his valuable criticism and help.

IV. The Probable Error of a Mendelian Class Frequency.

EDITORIAL.

Dr Raymond Pearl in a recent paper entitled "The Probable Error of a Mendelian Class Frequency*," provides a striking illustration of how the capable biologist needs a long continued training in the logic of mathematics before he ventures into the field of probability. Dr Pearl writes: "With the increased volume of Mendelian experimentation there is an ever-growing need for adequate and clearly understood tests for the statistical significance of differences between observed results and expectation." Now there is absolutely no obscurity about the test for a *single* class frequency in a Mendelian result. I cannot conceive that there ever could be or ever has been such obscurity in the mind of a trained mathematician. If on the basis of Mendelian theory the relative frequency of that class be $\bar{p}$ and the relative frequency of all other classes be $1 - \bar{p} = \bar{q}$, then in observation samples of m, the frequencies of this particular class distribute themselves according to the binomial law $N(\bar{p} + \bar{q})^m$ in N samples. To determine the impro-

* *American Naturalist*, Vol. LI. p. 144, March, 1917.

bability of any observed result we have only to calculate the terms of this series. The mean of this frequency distribution is well known to be $m\bar{p}$, and its standard deviation $\sqrt{m\bar{p}\bar{q}}$. When neither $\bar{p}$ nor $\bar{q}$ is very small, then for practical purposes (when m of course is of a fair size, not a few units) it is quite adequate to calculate the probabilities of occurrence in such a single class frequency by the tables of the probability integral. The Mendelian worker who wishes to be more exact has merely to evaluate the terms of the binomial, or if m be too large, to approximate to those terms by the aid of my Type III curve, which falls for the cases excepted above much closer to the binomial than the normal curve does*.

Two observations may here be made: First, if according to Mendelian theory there must be zero frequency in any particular class, then the improbability of any occurrence in that class is infinite. Secondly, the χ^2 test can be applied to any number whatever of Mendelian classes, to s classes individually and all the remainder, or in a particular case to *one* class and all the remainder. When applied to one class and all the remainder, it reduces to exactly the process given above, i.e. to the application of the probability table on the basis of the standard deviation $\sqrt{m\bar{p}\bar{q}}$; or, referring to the genesis of the χ^2 test, which started by replacing the binomial by a normal curve, to using if we please the binomial. There is thus no contradiction between the two methods. This absence of contradiction was indicated by me in *Biometrika*, Vol. IX. p. 312, and was perfectly familiar to Weldon, who applied the binomial test to cases where it is proper to apply it. Now let us examine Dr Pearl's remarks in the light of these observations. He writes of Weldon's and Johannsen's use of the standard deviation of the binomial for entering the probability tables†: "In the first place it assumes the Gaussian distribution of errors, an assumption not often strictly warranted, as Pearson has clearly shown, and in many cases grossly in error." Now this statement requires considerable modification, (i) it does not assume the Gaussian law of errors, but the fact that the Gaussian or better Laplacian integral for practical purposes gives adequately the frequencies of the binomial when extreme values of m, $\bar{p}$ and $\bar{q}$ are not included. Dr Pearl makes no attempt to show that Weldon (or Johannsen for the matter of that) was dealing with such extreme cases, but repeats the suggestion of his previous paper‡ that Weldon somehow blundered. (ii) Further Dr Pearl cites for my view on the subject my paper "On the Influence of Past Experience on Future Expectation§." In that paper, which deals as we shall show below with an entirely different matter, the standard deviation is not $\sqrt{m\bar{p}\bar{q}}$, but the standard deviation characteristic of a *second* sample, so that criticism on this ground is out of place. Incidentally, however, I do recite in that paper the warning as to the use of the Laplacian integral when m, $\bar{p}$, or $\bar{q}$ are extreme, and it was open to Dr Pearl to investigate whether Weldon had used the χ^2 test in such cases.

Let us look again at Dr Pearl. He writes: "The χ^2 test gives a measure of the goodness of fit of the *whole* distribution, and *only* that. Now besides being interested in that point the Mendelian worker quite as often wants to know, in addition, something about the probability that *particular classes* observed are significantly different from the expected. To that sort of knowledge the χ^2 test helps him not at all. It is an 'all or none' sort of method||."

Now Dr Pearl's italics absolutely give him away, for they demonstrate that he does not in the least understand how to handle the χ^2 test or what it means! Any test applied to s out of n classes must of course include the remaining $n - s$ classes as a single group, for their total frequency is *fixed*, when the frequencies of the s classes are given. The χ^2 test can be applied to a single class or to any number of classes up to $n - 1$, and it can only be a total misunderstanding of the test which can lead Dr Pearl to say that it is an "all or none" sort of method. Every test is an "all or none" test, if Dr Pearl means that it involves the *total number observed*.

* The area of Type III curve up to any deviation from the mean is given by the incomplete Γ-function. Tables of that function have been long in hand and are approaching completion and publication. Delay has arisen only from urgent war work.

† *Loc. cit.*, p. 144. ‡ *Journal of Experimental Zoology*, Vol. XIII. p. 203 *et seq.*

§ *Phil. Mag.*, March, 1907, pp. 365–378. || *Loc. cit.*, p. 145.

Again let me cite Dr Pearl: "The χ^2 test leads to this absurdity: if I perform a Mendelian experiment in which I get ten thousand million offspring agreeing *perfectly* with expectation save for *one* lone individual (perhaps a mutation, perhaps a mistake in the record, or what not) which is of a sort not expected, then Pearson and the χ^2 test agree that the probability is infinitely great that the ten thousand million *do not* follow Mendelian law!*"

Now this paragraph is I fear "characteristically" partizan, for in my criticism of Dr Pearl's paper I said nothing whatever about ten thousand millions obeying or not obeying the Mendelian law. Dr Pearl in his paper on the inheritance of fertility in hens got very frequently (from my standpoint) exceptions to his Mendelian theory. He drew in fact blue balls from a bag which his theory asserted contained only green or red balls. As a result he rejected the "goodness of fit" theory, which provided as it ought to do an infinite improbability. I asserted that he must either "remould his theory or explain away his observations†"; it was not a question of my test being fallacious. That he appears to be doing now when he states that exceptions may be "mutations" or "mistakes in records" or "what nots," or as he did in his original paper when he remarked of such exceptions that they are of "a type which is continually arising in Mendelian work." In other words he then emphasised and now again emphasises the "elasticity" of his observations. That is certainly the horn of the dilemma upon which I was prepared to drive him. But he is not content with such elasticity of Mendelism, or with badness of records or with "what nots," he seeks to show that a true test of Mendelian theory will be as plastic as the observations are elastic, in which case he will have successfully polled both horns.

In order to achieve this end he starts with a paper of mine published in the *Philosophical Magazine* for 1907, which he describes as "a very important paper, which is apparently almost entirely unknown to biologists." While feeling grateful for the compliment, I regret that it should be brought to the notice of biologists in regard to a matter which it cannot possibly cover. Let me briefly state the purport of that paper. A bag, a population, or a theoretical frequency is presented, the distribution law of which is *absolutely unknown*. The number in this fundamental distribution is supposed indefinitely great or else individuals must be returned before each draw. A first sample of n is drawn of which p present one characteristic and q do not. A second sample of m is now drawn, what is the chance that r individuals of this m will present the characteristic?

I showed that the mean of second samples would be

$$m\frac{p}{n} + \frac{m}{n+2}\frac{q-p}{n} \quad \text{.....(i),}$$

and the standard deviation σ would be given by

$$\sigma^2 = m\left(\frac{p}{n} + \frac{q-p}{n(n+2)}\right)\left(\frac{q}{n} - \frac{q-p}{n(n+2)}\right)\left(1 + \frac{m-1}{n+3}\right) \quad \text{.....(ii),}$$

the whole frequency distribution being provided by a hypergeometrical series. It is this hypergeometrical series which Dr Pearl proposes to employ as a test of "goodness of fit" in Mendelian class frequencies.

At first sight it seems almost impossible to determine how it can be applied, for the Mendelian Law which *is supposed known* is the theoretical frequency, the bag or original population, which my memoir supposes to be *unknown* except as suggested by the first sample. The only adequate method of applying the theory—and then it would be using a sledge hammer to crack nuts—would be to suppose the *first* sample indefinitely large. In this case p/n represents the class frequency of Mendelian theory $\bar{p}$, and the ratio of the observed sample m to the total possible Mendelian population n is vanishingly small, and accordingly there results

$$\text{mean} = m\bar{p}, \qquad \sigma^2 = m\bar{p}\bar{q},$$

and the hypergeometrical series collapses into $N(\bar{p} + \bar{q})^m$. Thus we fall back on the obvious binomial test with its infinite improbability for the cases of $\bar{p} = 0$, which Dr Pearl finds not

* *Loc. cit.*, p. 145.

† *Biometrika*, Vol. IX. p. 312.

"plastic" enough for his observations. But this, the logical application of the method, is not what Dr Pearl adopts although he has commenced his paper by emphasising the "ever-growing need for adequate and clearly understood tests for the statistical significance of differences between *observed results* and *expectation**" and cited in this respect the χ^2 and the $\sqrt{mpq}$ tests both of which are criteria of goodness of fit of observed results as a sample of the results to be expected from an indefinitely large and rigidly proportioned theoretical population.

What Dr Pearl actually does had better be stated in his own words (italics his): "The proposal which I wish to make for the expression of a Mendelian result is that *the expectation be expressed as the quartile limits of each class of frequency in a second sample of the same size as the observed sample*†."

Now it is very difficult to understand this sentence, for we are not told what the "expectation" is. If it is the Mendelian expectation, then why is the Mendelian expectation the second sample and not the first sample? And further why should its size be the *same* as that of the observation and not indefinitely large?

If we seek enlightenment in the working of the illustrations provided we can find it on pp. 150–151. Here to begin with we have the observations of F. L. Platt on the mating of Blue Andalusian fowls set out. There are 58 offspring of the mating Blue × Blue of which almost 7 % instead of being the white, blue or black of Mendelian theory are "dark red." These "mutations," "errors of record" or "what nots" are thrown in with the blacks and classed as "pigmented not blue" (elastic observations!). Dr Pearl now assumes a *first* sample of 58 to be given in the actual Mendelian proportions of 1 : 2 : 1, i.e., 14·5 : 29 : 14·5, and he then uses (i) and (ii) to obtain the mean = 14·9833 and $\sigma = 4{\cdot}6364$ for testing the actual data.

Now what is the real significance of this procedure? Clearly he has made the Mendelian theory absolutely *plastic*. He has taken it not as the rigid law of the population sampled, but as the variable distribution of a very small first sample of 58 from a population of which the actual law is *absolutely unknown* or rather merely suggested by a very small sample. The smaller the observed series, the weaker will be the theory. The artifice is clear when it is clearly expressed, but no biologist with the average biologist's knowledge of mathematics would realise what Dr Pearl has done and he would thus run the danger of accepting Dr Pearl's test as a valid one. Suppose the *sampled* population to contain 1000 blue balls, 800 green balls, 500 red balls and 10 yellow balls. A sample of 50 would as a rule produce no yellow balls, say it produced 22 blue, 17 green and 11 red. This would be used to represent the "Mendelian" ratio 22 : 17 : 11 but later samples of 50 might occasionally produce yellow balls. These it is true would not appear in the "Mendelian theory" of 22 : 17 : 11, but would give no indefinite improbability, because the Mendelian theory has been shifted from being the rigid law of an indefinitely large population, to being the chance distribution of a sample, *of just the same size as the observations themselves.* Its accuracy or weight fluctuates with the observations themselves, and the "goodness of fit" test suggested by this process becomes no test whatever of the accordance of theory and observation, for the theory is made to have just the same weight as the observations, and the fewer the observed data, the greater *ceteris paribus* will be the likelihood of accordance between the two samples.

Shortly Dr Pearl's method is entirely fallacious, as any trained mathematician would have informed Dr Pearl had he sought advice before publication. It is most regrettable that such extensions of biometric theory should be lightly published, without any due sense of responsibility, not solely in biological but in psychological journals. It can only bring biometry into contempt as a science if, professing a mathematical foundation, it yet shows in its manifestations most inadequate mathematical reasoning.

* *Loc. cit.*, p. 144. The italics are mine.

† *Loc. cit.*, p. 148.

NOTE.

With this double Part of *Biometrika* is issued an Appendix containing the Records of the late W. F. R. Weldon's Mice Breeding Experiments. It was intended originally to issue these Records as an Appendix to the memoir in which the reduced observations are discussed. While the reductions have made considerable progress there has been unfortunately great delay in their completion owing to Assistants to whom they were entrusted being called away for other work, and owing to the whole Laboratory Staff for the past twelve months having other duties. As the present Records were set up more than two years ago, it is convenient to issue them at once, in anticipation of the explanatory memoir, which, it is hoped, will not be too long delayed. The determinations of colour and extent of pigmentation from the scales are due to F. J. W. upon whom also the more laborious part of the preparation for press of these Records has fallen. K. P.

APPENDIX TO BIOMETRIKA.

W. F. R. WELDON'S MICE BREEDING EXPERIMENTS.

RECORDS OF MATINGS.

For an Explanation of the Symbols used and Notes on the Individual Mice, see the conclusion of the Records.

MATING	OFFSPRING				PARENTS	
					Father	Mother
0*H*1	a^1 ♂ *45 q*49.46. 2(2*d*)	a^2 ♂ *55 q*49. 1. 1(3*c*)	a^3 ♂ *45 q*48. 1. 1(2*c*)	a^4 ♀ − *q* − − −(1*c*)	*W* no. 1 ♂ *p* − − −(*Wa*β)	*Lb* no. 1 ♀ *00p* − − −(*A* × 1 or 2)
	a^5 ♀ − *q* − − −(1*c*)	a^6 ♀ − *q* − − −(3*c*)	... ...	... ...	... ...	... ...
0*H*6	a^1 ♀ − *q* − − −(2*c*)	... ...	... ...	... ...	*W* no. 6 ♂ *p* − − −(*W*β)	*Lb* no. 6 ♀ *00p* − − −(*A* × 1 or 2)
0*H*7	a^1 ♂ *100zq*49.46. 7(5*c*)	a^2 ♂ *45 q*48. 1. 1(2*c*)	a^3 ♂ *55 q*49.46. 2(2–3*c*)	a^4 ♂ *55 q*49.21. 2(3*d*)	*W* no. 7 ♂ *p* − − −(*Wa*)	*Bt* no. 7 ♀ *00p* − − −(*A*1)
	a^5 ♀ *50 q*48.36. 2(3*c*)	a^6 ♀ *100zq*48.46.12(5*c*)	a^7 ♀ − *q* − − −(2*d*)	... ...	... ...	... ...
0*H*8 (or 7)	a^1 ♂ *100zq*48.36. 7(5*c*)	a^2 ♂ *100zq*49.46. 7(5*c*)	a^3 ♀ − *q* − − −(5*c*)	a^4 ♀ − *q* − − −(5*c*)	*W* no. 7 ♂ *p* − − −(*Wa*)	(*Bt* no. 8 ♀ *00p* − − −(*A*1)
					W no. 8 ♂ *p* − − −(*W*β)	) (or 7)
	a^5 ♀ *100zq* 49.46.12(5*c*)	a^6 − *q* − − −(5*c*)	... ...	... ...	... ...	... ...
0*H*9	a^1 ♂ − *q* − − −(2*c*)	a^2 ♀ *30 q*46. 1. 1(2*c*)	a^3 ♀ *45 q*48.46. 1(2*c*)	a^4 ♀ *50 q*49. 1. 1(2*c*)	*W* no. 1 ♂ *p* − − −(*Wa*β)	*Lb* no. 9 ♀ *00p* − − −(*A* × 1 or 2)
	a^5 ♀ *25 q*46. 1. 1(2*c*)	a^6 ♀ *40 q*49. 1. 1(2*d*)	... ...	... ...	... ...	... ...
0*H*12	a^1 ♂ − *q* − − −(5*c*)	a^2 ♂ − *q* − − −(5*c*)	a^3 ♀ − *q* − − −(5*a*)	a^4 ♀ − *q* − − −(5*c*)	*W* − ♂ *p* − − −(*Wa*)	*Bt* no. 11 ♀ *00p* − − −(*A*1 ?)
	a^5 ♀ − *q* − − −(5*a*)	... ...	... ...	... ...	... ...	... ...
0*H*13	a^1 ♂ *50 q*46.46. 1(3*c*)	a^2 ♂ *100zq*48.46. 7(5*c*)	a^3 ♂ *100zq*49.46. 7(5*d*)	a^4 ♂ *45 q*52. 1. 1(3*c*)	*W* no. 12 ♂ *p* − − −(*Wa*)	*Bt* no. 12 ♀ *00p* − − −(*A*1 ?)
0*H*16	a^1 ♂ *50 q*47. 1. 1(3*c*)	a^2 ♀ *50 q*48.46. 1(3*c*)	a^3 ♀ *50 q*48. 1. 1(3*c*)	a^4 ♀ *55 q*49.46. 1(4*c*)	*W* no. 8 ♂ *p* − − −(*W*β)	*Lb* no. 13 ♀ *00p* − − −(*A* × 1 or 2)
	a^5 ♀ − *q* − − −(4*c*)	... ...	... ...	... ...	... ...	... ...
0*H*20	a^1 ♂ *55 q*47.46. 1(3*d*)	a^2 ♂ *40 q*48.46. 1(2*c*)	a^3 ♂ *100zq*48.46. 7(5*d*)	a^4 ♀ *45 q*49. 1. 1(2*d*)	*W* no. 1 ♂ *p* − − −(*Wa*β)	*Bt* no. 15 ♀ *00p* − − −(*A*1 ?)
	a^5 ♀ *25 q*49. 1. 1(2*d*)	a^6 − *q* − − −(5 *l*)	... ...	... ...	... ...	... ...
0*H*27	a^1 ♀ *40 q*58. 1. 2(2*c*)	... ...	... ...	... ...	*Bt* − ♂ *00p* − − −(*A*1 ?)	*W* no. 24 ♀ *p* − − −(*W*aβ)
0*H*33	a^1 − *q* − − −(5*c*)	... ...	... ...	... ...	*Bt* − ♂ *00p* − − −(*A*1 ?)	*W* no. 43 ♀ *p* − − −(*Wa*)
0*H*35	a^1 ♂ − *q* − − −(2*c*)	a^2 ♀ − *q* − − −(3*d*)	a^3 ♀ − *q* − − −(3*d*)	a^4 ♀ − *q* − − −(2*d*)	*W* − ♂ *p* − − −(*Wa* ?)	*Lb* − ♀ *p* − − −(*A* × 1 or 2)
	a^5 ♂ − *q* − − −(4*d*)	a^6 ♂ − *q* − − −(4*d*)	... ...	... ...	... ...	... ...
0*H*45	a^1 ♀ − *q* − − −(2*d*)	a^2 ♂ − *q* − − −(2*d*)	a^3 ♂ − *q* − − −(2*d*)	a^4 ♀ − *q* − − −(2*d*)	*W* no. 6 ♂ *p* − − −(*W*β)	*Bt* − ♀ *00p* − − −(*A*1 ?)
0*H*53	a^1 − *q* − − −(4*c*)	... ...	... ...	... ...	*Bt* − ♂ *00p* − − −(*A*1 ?)	*W* no. 22 ♀ *p* − − −(*W*β)
0*H*59	a^1 ♀ *50 q*48. 1. 4(3*d*)	a^2 ♂ *100zq*49.46. 7(6*d*)	... ...	... ...	*Bt* − ♂ *00p* − − −(*A*1)	*W* no. 34 ♀ *p* − − −(*Wa*)
0*H*61	a^1 ♂ − *q* − − −(2*c*)	a^2 ♂ − *q* − − −(5*c*)	a^3 ♂ − *q* − − −(5*c*)	a^4 ♂ − *q* − − −(5*c*)	*W* no. 39 ♂ *p* − − −(*Wa*β)	*Bt* no. 12 ♀ *00p* − − −(*A*1 ?)
	a^5 ♀ *80 q*46. 1. 1(4*c*)	a^6 ♀ *65 q*49.30. 7(3*c*)	a^7 ♀ − *q* − − −(5*c*)	... ...	... ...	... ...
0*H*62	a^1 ♂ − *q* − − −(2*c*)	a^2 ♂ *40 q*49. 1. 1(3*c*)	a^3 ♀ *45 q*48.34. 3(3*c*)	a^4 ♀ *100zq*49.46. 7(5*c*)	*W* no. 54 ♂ *p* − − −(*W*β)	*Bt* − ♀ *00p* − − −(*A*1)
	a^5 ♀ *100zq*49.48.12(5*c*)	a^6 ♀ *100zq*49.46.12(5*c*)	... ...	... ...	... ...	... ...
0*H*66	a^1 − *q* − − −(5*c*)	... ...	... ...	... ...	*Bt* − ♂ *00p* − − −(*A*1 ?)	*W* no. 38 ♀ *p* − − −(*W*β)
0*H*72	a^1 − *q* − − −(5*c*)	... ...	... ...	... ...	*Bt* − ♂ *00p* − − −(*A*1 ?)	*W* − ♀ *p* − − −(*Wa*β)
0*H*73	a^1 ♀ − *q* − − −(5*c*)	a^2 ♀ − *q* − − −(5*c*)	a^3 ♀ − *q* − − −(5*c*)	a^4 ♂ − *q* − − −(3*c*)	*W* − ♂ *p* − − −(*Wa*3)	*Bt* − ♀ *00p* − − −(*A*1)
	a^1 ♀ − *q* − − −(3*c*)	a^6 ♂ − *q* − − −(3*c*)	... ...	... ...	... ...	... ...
0*H*74	a^1 ♂ − *q* − − −(4*c*)	a^2 ♂ − *q* − − −(3*c*)	a^3 ♂ − *q* − − −(4*c*)	a^4 ♂ − *q* − − −(4*c*)	*W* − ♂ *p* − − −(*Wa*β)	*Bt* − ♀ *00p* − − −(*A*1 ?)
	a^5 ♀ *80 q*49.46. 2(4*c*)	a^6 ♀ *80 q*49.48. 1(4*c*)	a^7 ♀ *80 q*49.46. 1(4*c*)	a^8 ♀ − *q* − − −(4*c*)	... ...	... ...
0*H*75	a^1 ♀ *60 q*49.48. 1(4*c*)	a^2 ♂ *35 q*49. 1. 1(2*c*)	a^3 ♀ *45 q*49. 1. 1(2*c*)	a^4 ♀ *45 q*49.46. 1(3*c*)	*W* − ♂ *p* − − −(*Wa*3)	*Bt* − ♀ *00p* − − −(*A*1 ?)
	a^5 ♂ *15 q*49. 1. 1(1*c*)	... ...	... ...	... ...	... ...	... ...
0*H*77	a^1 ♂ *100zq*48.46. 7(5*c*)	a^2 ♂ *60 q*48.46. 4(4*c*)	a^3 ♂ *55 q*48.46. 1(4*c*)	a^4 ♀ − *q* − − −(5*c*)	*W* no. 16 ♂ *p* − − −(*Wa*β)	*Bt* − ♀ *00p* − − −(*A*1 ?)
	a^5 ♀ − *q* − − −(5*c*)	a^6 ♀ *100zq*57.56.56(5*e*)	a^7 ♀ *70 q*61.61. 1(4*e*)	a^8 ♀ − *q* − − −(5*c*)	... ...	... ...
0*H*78	a^1 ♀ − *q* − − −(5*e*)	a^2 − *q* − − −(5*d*)	a^3 ♀ − *q* − − −(2*e*)	a^4 ♀ − *q* − − −(3*e*)	*W* no. 8 ♂ *p* − − −(*W*β)	*Bt* no. 58 ♀ *00p* − − −(*A*1 ?)
0*H*82	a^1 ♀ *55 q*48.46.12(3*c*)	a^2 ♀ − *q* − − −(5*c*)	... ...	... ...	*A*1a^1 ♂ *00p* − − −(*A*2½)	*W* − ♀ *p* − − −(*W*β)
0*H*84	a^1 ♀ − *q* − − −(5*c*)	a^2 ♀ *100zq*49.46. 4(5*c*)	a^3 ♀ *100zq*35.33.30(5*a*)	a^4 ♀ *100zq*35.33.30(5*a*)	*W* no. 54 ♂ *p* − − −(*W*β)	*Bt* no. 11 ♀ *00p* − − −(*A*1 ?)
	a^5 ♀ *100zq*33.30.28(5*a*)	a^6 ♀ *100zq*39.33.30(5*a*)	a^7 ♂ *100zq*35.33.28(5*a*)	a^8 ♂ − *q* − − −(5*c*)	... ...	... ...
	a^9 ♂ *100zq*48.46.28(5*c*)	... ...	... ...	... ...	... ...	... ...
0*H*85	a^1 ♀ − *q* − − −(4*d*)	a^2 ♂ − *q* − − −(3*e*)	a^3 ♀ − *q* − − −(5*d*)	a^4 ♀ − *q* − − −(5–6*d*)	*W* − ♂ *p* − − −(*Wa*)	*Lb* no. 13 ♀ *00p* − − −(*A* × 1 or 2)
	a^5 ♂ − *q* − − −(5*d*)	a^6 ♂ − *q* − − −(5*e*)	a^7 − *q* − − −(3*e*)	... ...	... ...	... ...

0*H* 86	a^1 ♂ *100zq* 49.46. 9(5*c*)	a^2 ♂ *100zq* 49.46.28(5*c*)	a^3 ♀ – *q* – – –(3*c*)	a^4 ♀ – *q* – – –(3*c*)	*W* – ♂ *p* – – –(*Wa*3)	*Bt* no. 59 ♀ *00p* – – –(*A* 1 ?)
	a^5 ♀ – *q* – – –(5*c*)	a^6 ♀ – *q* – – –(5*c*)	a^7 ♀ – *q* – – –(5*c*)	... ...	... ...	... ...
0*H* 90	a^1 ♀ – *q* – – –(5*c*)	a^2 ♂ – *q* – – –(5*c*)	... ...	... ...	*W* no. 35 ♂ *p* – – –(*Wa*3)	*Bt* – ♀ *00p* – – –(*A* 1 ?)
0*H* 91	a^1 – *q* – – –(6*c*)	... ...	... ...	... ...	*A* 1a^2 ♂ *00p* – – –(*A* 2½)	*W* no. 46 ♀ *p* – – –(*Wa*)
0*H* 94	a^1 ♀ *60 q*49.46. 1(3*c*)	a^2 – *q* – – –(3*c*)	... ...	... ...	*A* 4a^2 ♂ *00p* – – –(*A* 2½)	*W* no. 33 ♀ *p* – – –(*Wa*)
0*H* 100	a^1 ♂ *40 q*49. 1. 1(3*c*)	a^2 ♂ – *q* – – –(5*c*)	a^3 ♂ – *q* – – –(5*c*)	a^4 ♂ *100z*$_1$49.46. 7(5*c*)	*W* no. 54 ♂ *p* – – –(*Wβ*)	*A* 1a^5 ♀ *00p* – – –(*A* 2½)
	a^5 ♀ *25 q*46. 1. 1(2*c*)	a^6 ♀ *55 q*49.46. 9(3*c*)	a^7 ♀ – *q* – – –(5*c*)	a^8 ♀ – *q* – – –(5*c*)	... ...	... ...
	a^9 – *q* – – –(3*c*)	... ...	... ...	... ...	... ...	... ...
0*H* 101	a^1 ♂ *45 q*49. 1. 1(2*c*)	a^2 ♂ *50 q*49.46. 4(3*c*)	a^3 ♂ – *q* – – –(5*c*)	a^4 ♂ – *q* – – –(5*c*)	*W* no. 54 ♂ *p* – – –(*Wβ*)	*A* 1a^6 ♀ *00p* – – –(*A* 2½)
	a^5 ♂ *100zq* 48.46.12(5*c*)	a^6 ♀ *45 q*49.46. 1(3*c*)	a^7 ♀ – *q* – – –(4*c*)	a^8 ♀ – *q* – – –(5*c*)	... ...	... ...
	a^9 – *q* – – –(5*c*)	... ...	... ...	... ...	... ...	... ...
0*H* 102	a^1 ♂ *70 q*48.46. 2(4*c*)	a^2 ♂ *55 q*48. 1. 2(3*c*)	a^3 ♂ *95 q*48.46. 7(4*c*)	a^4 ♂ – *q* – – –(5*c*)	*W* no. 54 ♂ *p* – – –(*Wβ*)	*A* 1a^7 ♀ *00p* – – –(*A* 2½)
	a^5 ♀ – *q* – – –(5*c*)	a^6 ♀ – *q* – – –(5*c*)	a^7 ♀ *100zq* 49.46.14(5*c*)	a^8 – *q* – – –(4*c*)	... ...	... ...
	a^9 – *q* – – –(4*c*)	... ...	... ...	... ...	... ...	... ...
0*H* 103	a^1 ♂ – *q* – – –(5*c*)	a^2 ♂ – *q* – – –(5*c*)	a^3 ♂ – *q* – – –(5*c*)	a^4 ♀ *55 q*49. 1. 3(3*c*)	*W* – ♂ *p* – – –(*Wαβ*)	*A* 1a^8 ♀ *00p* – – –(*A* 2½)
	a^5 ♀ *55 q*49.46. 4(3*c*)	a^6 ♀ *50 q*49.46. 3(3*c*)	a^7 – *q* – – –(5*c*)	a^8 – *q* – – –(2*c*)	... ...	... ...
0*H* 104	a^1 ♀ – *q* – – –(2*c*)	a^2 ♀ – *q* – – –(1*c*)	a^3 ♂ *40 q*46. 1. 1(3*c*)	a^4 ♂ *40 q*48.46. 2(3*c*)	*W* – ♂ *p* – – –(*Wαβ*)	*A* 1a^9 ♀ *00p* – – –(*A* 2½)
	a^5 – *q* – – –(4*c*)	a^6 – *q* – – –(2*c*)	a^7 – *q* – – –(5*c*)	... ...	... ...	... ...
0*H* 107	a^1 ♂ *100zq* 49.46.20(5*c*)	a^2 ♂ *55 q*61.57. 1(3*e*)	... ...	... ...	*A* 13a^1 ♂ *00p* – – –(*A* × 3)	*W* no. 24 ♀ *p* – – –(*Wa*3)
0*H* 108	a^1 ♂ – *q* – – –(5*c*)	... ...	... ...	... ...	*A* 5a^1 ♂ *00p* – – –(*A* × 3)	*W* no. 47 ♀ *p* – – –(*Wa*3)
0*H* 110	a^1 ♂ *60 q*48.46. 1(3*c*)	a^2 ♀ *60 q*52.46. 2(3*c*)	... ...	... ...	*A* 14a^2 ♂ *00p* – – –(*A* 1)	*W* no. 44 ♀ *p* – – –(*Wa*3)
0*H* 111	a^1 ♂ – *q* – – –(5*d*)	a^2 ♂ – *q* – – –(5*α*)	a^3 ♀ – *q* – – –(5*d*)	a^4 ♀ – *q* – – –(5*d*)	*W* no. 39 ♂ *p* – – –(*Wa*3)	*Bt* no. 11 ♀ *00p* – – –(*A* 1 ?)
	a^5 ♀ – *q* – – –(5*d*)	a^6 ♀ – *q* – – –(5*d*)	a^7 ♀ – *q* – – –(5*a*)	a^8 ♀ *100zq* 35.35.30(5*a*)	... ...	... ...
	a^9 ♀ *100zq* 35.34.29(5*a*)	a^{10} ♀ – *q* – – –(5*a*)	... ...	... ...	... ...	... ...
0*H* 112	a^1 ♂ *30 q*49. 1. 1(2*c*)	a^2 ♂ – *q* – – –(5*c*)	a^3 ♀ *50 q*48.46. 1(3*c*)	a^4 ♀ *35 q*46. 1. 1(2*c*)	*W* no. 54 ♂ *p* – – –(*Wβ*)	*A* 5a^3 ♀ *00p* – – –(*A* × 3)
	a^5 ♀ *40 q*49. 1. 1(2*c*)	... ...	... ...	... ...	... ...	... ...
0*H* 113	a^1 ♀ – *q* – – –(4*c*)	a^2 ♀ *50 q*49.46. 2(3*c*)	a^3 ♀ – *q* – – –(3*c*)	a^4 ♀ *100zq* 49.46.12(5*c*)	*W* – ♂ *p* – – –(*Wαβ*)	*A* 8a^1 ♀ *00p* – – –(*A* × 2 or 3)
	a^5 ♀ *100zq* 48.46.43(5*c*)	a^6 ♀ *100zq* 49.36.20(5*c*)	a^7 ♂ *q* – – –(5*c*)	a^8 ♂ – *q* – – –(5*c*)	... ...	... ...
0*H* 114	a^1 ♀ – *q* – – –(5*c*)	a^2 ♀ *35 q*49.46. 1(3*c*)	a^3 ♀ *100zq* 49.46.12(5*c*)	a^4 ♂ *50 q*46.30. 5(3*c*)	*W* – ♂ *p* – – –(*Wa*3)	*A* 8a^2 ♀ *00p* – – –(*A* × 2 or 3)
	a^5 ♂ *25 q*49. 1. 2(2*c*)	a^6 ♂ – *q* – – –(5*c*)	... ...	... ...	... ...	... ...
0*H* 117	a^1 ♀ *80 q*49.46. 1(4*c*)	a^2 ♀ *95 q*49.46. 4(4*c*)	a^3 ♀ – *q* – – –(3*c*)	a^4 ♀ *90 q*49.36. 1(4*c*)	*W* no. 39 ♂ *p* – – –(*Wαβ*)	*A* 27a^4 ♀ *00p* – – –(*A* × 3)
	a^5 ♀ *65 q*49.36. 4(3*c*)	a^6 ♂ *65 q*48.46. 3(3*c*)	a^7 ♂ *90 q*49.46. 9(4*c*)	... ...	... ...	... ...
0*H* 118	a^1 ♂ *85 q*48.46.11(4*c*)	a^2 ♀ – *q* – – –(5*c*)	a^3 ♀ – *q* – – –(5*c*)	a^4 – *q* – – –(5*c*)	*W* no. 39 ♂ *p* – – –(*Wa*3)	*A* 27a^5 ♀ *00p* – – –(*A* × 3)
	a^5 – *q* – – –(4*c*)	... ...	... ...	... ...	... ...	... ...
0*H* 120	a^1 ♂ – *q* – – –(4*c*)	a^2 ♂ – *q* – – –(3*c*)	a^3 ♀ *45 q*49. 1. 1(2*c*)	a^4 ♂ *60 q*49.46. 1(3*c*)	*W* no. 35 ♂ *p* – – –(*Wαβ*)	*A* 6a^1 ♀ *00p* – – –(*A* × 2)
	a^5 ♂ – *q* – – –(2*c*)	a^6 ♀ *75 q*49.46. 1(4*c*)	a^7 ♂ *50 q*48.46. 3(3*c*)	a^8 ♀ – *q* – – –(2*c*)	... ...	... ...
0*H* 124	a^1 ♂ *100zq* 49.21.20(4*c*)	a^2 ♀ *90 q*49.34. 1(4*c*)	a^3 ♀ – *q* – – –(4*c*)	a^4 – *q* – – –(4*c*)	1*H* 11a^1 ♂ *00p* – – –(*A* × 2)	*W* – ♀ *p* – – –(*Wαβ*)
0*H* 125	a^3 *100z* 53.51.14	... ...	... ...	... ...	1*H* 14a^1 ♂ *00p* – – –(*A* × 2)	*W* no. 38 ♀ *p* – – –(*Wβ*)
0*H* 127	a^1 ♀ *50 q*53. 1. 1(3*c*)	a^2 ♂ *50 q*52.46. 1(3*c*)	a^3 ♂ *50 q*52. 1. 2(3*c*)	a^4 ♂ – *q* – – –(3*c*)	*W* no. 35 ♂ *p* – – –(*Wαβ*)	1*H* 12a^1 ♀ *00p* – – –(*A* × 2)
	a^5 ♂ *65 q*49.46. 1(4?*c*)	... ...	... ...	... ...	... ...	... ...
0*H* 128	a^1 ♀ *85 q*49.46. 1(4*c*)	a^2 – *q* – – –(3*cw*)	a^3 – *q* – – –(3*cw*)	a^4 – *q* – – –(3*c*)	*W* no. 39 ♂ *p* – – –(*Wαβ*)	1*H* 2a^1 ♀ *00p* – – –(*A* × 2)
0*H* 129	a^1 ♀ – *q* – – –(3*c*)	a^2 ♀ *50 q*49. 1. 1(3*c*)	a^3 ♀ *25 q*49. 1. 1(2*c*)	a^4 ♂ *35 q*46.46. 3(2*c*)	*W* – ♂ *p* – – –(*Wαβ*)	1*H* 24a^1 ♀ *00p* – – –(*A* × 2)
	a^5 ♂ *35 q*49. 1. 1(3*c*)	a^6 ♂ *35 q*49.36. 1(2*c*)	... ...	... ...	... ...	... ...
0*H* 130	a^1 – *q* – – –(2*c*)	a^2 – *q* – – –(2*c*)	... ...	... ...	*W* no. 36 ♂ *p* – – –(*Wαβ*)	1*H* 20a^2 ♀ *00p* – – –(*A* × 1)
0*H* 131	a^1 ♂ *100zq* 35.33.29(4–5*a*)	a^2 ♀ *60 q*49.46. 3(3*d*)	a^3 ♀ *95 q*35.35. 2(4*a*)	a^4 ♀ *95 q*35.35.29(6*a*)	*W* no. 42 ♂ *p* – – –(*Wa*3)	1*H* 40a^1 ♀ *00p* – – –(*A* × 2)
	a^5 – *q* – – –(6*a*)	... ...	... ...	... ...	... ...	... ...
0*H* 132	a^1 ♀ *80 q*49.46. 7(5*c*)	a^2 ♀ – *q* – – –(5*cw*)	a^3 ♀ *100zp* 36.35.28(6*a*)	a^4 ♀ *100zp* 36.34. 4(6*a*)	*W* – ♂ *p* – – –(*Wαβ*)	1*H* 40a^2 ♀ *00p* – – –(*A* × 2)
	a^5 ♀ – *p* – – –(6*a*)	a^6 ♀ *100zp* 35.35. 4(6*a*)	a^7 – *q* – – –(5*c*)	... ...	... ...	... ...
0*H* 133	a^1 ♀ *100zq* 49.46.12(5*c*)	a^2 – *q* – – –(3*c*)	a^3 – *q* – – –(5*c*)	a^4 – *q* – – –(5*c*)	*W* no. 31 ♂ *p* – – –(*Wβ*)	1*H* 27a^1 ♀ *00p* – – –(*A* × 2)
0*H* 134	a^1 ♂ *55 p*37. 1. 1(3*a–b*)	a^2 – *q* – – –(3*c*)	... ...	... ...	*W* no. 31 ♂ *p* – – –(*Wβ*)	1*H* 27a^2 ♀ *00p* – – –(*A* × 2)

Mating	Offspring				Parents: Father	Parents: Mother
0*H* 135	a^1 ♂ *50 q*49.46. 1(3*c*)	a^2 ♀ *45 q*52.46. 1(2*cw*)	a^3 ♀ *45 q*49.46. 4(2*c*)	a^4 ♀ *100zq*49.48.14(5*c*)	*W* no. 35 ♂ *p* – – –(*Waβ*)	1*H*47a^1 ♀ *00p* – – –(*A* × 2)
	a^5 ♀ *100zq*49.46.12(5*cw*)	a^6 ♂ *30 q*48. 1. 1(2*cw*)	... ...	... ...	... ...	... ...
0*H* 136	a^1 ♂ *40 q*47.28. 2(3*c*)	a^2 ♂ *25 q*52. 1. 1(2*c*)	a^3 ♂ *25 q*48. 1. 1(2*c*)	a^4 ... – *q* – – –(5*c*)	*W* no. 39 ♂ *p* – – –(*Waβ*)	1*H*47a^2 ♀ *00p* – – –(*A* × 2)
	a^5 – *q* – – –(5*c*)	a^6 – *q* – – –(5*c*)	a^7 – *q* – – –(5*c*)	... ...	... ...	... ...
0*H* 138	a^1 ♀ – *q* – – –(5*c*)	a^2 ♀ – *q* – – –(5–6*c*)	a^3 ♂ – *q* – – –(5*c*)	a^4 ♀ *50 q*49. 1. 1 (3*c*)	*W* – ♂ *p* – – –(*Waβ*)	1*H*49a^1 ♀ *00p* – – –(*A* × 2)
0*H* 139	a^1 ♂ *20 q*49. 1. 2(2*c*)	a^2 ♂ – *q* – – –(5*c*)	a^3 ♀ *30 q*49. 1. 2(2*c*)	a^4 ♀ – *q* – – –(5*c*)	*W* no. 40 ♂ *p* – – –(*Waβ*)	1*H*32a^1 ♀ *00p* – – –(*A* × 2)
	a^5 ♀ – *q* – – –(5*c*)	a^6 – *q* – – –(2*c*)	... ...	... ...	... ...	... ...
0*H* 140	a^1 ♀ *35 q*53.53. 1(2*c*)	a^2 ♂ *85 q*52.53.12(4*c*)	a^3 ♀ *35 q*48. 1. 1(2*c*)	a^4 ♀ *25 q*49.46. 4(2*c*)	*W* no. 40 ♂ *p* – – –(*Waβ*)	1*H*32a^2 ♀ *00p* – – –(*A* × 2)
	a^5 ♂ *40 q*49.46. 1(3*c*)	a^6 ♀ *40 q*46. 1. 1(3*c*)	a^7 – *q* – – –(3*c*)	... ...	... ...	... ...
0*H* 142	a^1 ♂ *45 q*49. 1. 1(3*c*)	a^2 ♂ *40 q*49. 1. 1(2*c*)	a^3 ♂ *100zq*49.36. 7(5*c*)	a^4 ♀ *30 q*49. 1. 4(2*c*)	*W* no. 42 ♂ *p* – – –(*Waβ*)	*A*51a^1 ♀ *00p* – – –(*A* × 2)
	a^5 ♀ – *q* – – –(2*c*)	a^6 ♀ *80 q*49.36. 4(5*c*)	... ...	... ...	... ...	... ...
0*H* 143	a^1 ♂ – *q* – – –(5*c*)	a^2 ♀ – *q* – – –(5*c*)	a^3 ♂ – *q* – – –(5*c*)	a^4 ♀ – *q* – – –(5*c*)	*W* no. 35 ♂ *p* – – –(*Waβ*)	*Bt* – ♀ *00p* – – –(*A* × 1)
	a^5 ♂ – *q* – – –(5*c*)	a^6 ♀ – *q* – – –(5*c*)	a^7 – *q* – – –(5*c*)	... ...	... ...	... ...
0*H* 144	a^1 – *q* – – –(5*c*)	a^2 – *q* – – –(5*c*)	a^3 – *q* – – –(5*c*)	a^4 – *q* – – –(5*c*)	*W* no. 36 ♂ *p* – – –(*Waβ*)	*A*71a^1 ♀ *00p* – – –(*A*2 ♀)
	a^5 – *q* – – –(5*c*)	a^6 – *q* – – –(5*c*)	... ...	... ...	... ...	... ...
0*H* 145	a^1 ♂ *100zq*49.48. 9(5*c*)	a^2 ♂ *100zq*35.35.30(5*a–b*)	a^3 ♂ *100zq* 35.35.30(5*a–b*)	a^4 ♂ *100zq*36.30.28(5*a–b*)	1*H*42b^1 ♂ *p* – – –(3*a–bw*)	*A*30a^1 ♀ *00p* – – –(*A*2 ♀)
	a^5 ♂ *00 p* – – –(alb.)	a^6 ♀ *100zq*35.33.30(5–6*a–b*)	a^7 ♀ *100zq*39.35.30(5*a–b*)	a^8 ♀ *100zq*39.35.30(5–6*a–b*)	... ...	... ...
0*H* 146	a^1 ♂ *90 q*49.34. 2(4*c*)	a^2 ♂ *100zq*35.33. 4(5*a*)	a^3 ♂ *00 p* – – –(alb.)	a^4 ♀ – *q* – – –(5*c*)	1*H*42b^1 ♂ *p* – – –(3*a–bw*)	*A*30a^2 ♀ *00p* – – –(*A*2 ♀)
	a^5 ♀ *00 p* – – –(alb.)	a^6 ♀ *00 p* – – –(alb.)	a^7 ♀ *00 p* – – –(alb.)	a^8 – *q* – – –(5*c*)	... ...	... ...
0*H* 147	a^1 – *q* – – –(5*c*)	a^2 *100zq*53.51.14(5*c*)	a^3 – *q* – – –(5*c*)	a^4 – *q* – – –(5*c*)	*W* no. 37 ♂ *p* – – –(*Wβ*)	*A*67a^2 ♀ *00p* – – –(*A* × 1)
	a^5 – *q* – – –(5*c*)	a^6 – *q* – – –(5*c*)	... ...	... ...	... ...	... ...
0*H* 148	a^1 ♀ *55 q*53. 1. 1(3*c*)	a^2 ♀ *55 q*49.36. 3(3*c*)	a^3 ♀ *45 q*49.36. 1(3*c*)	a^4 – *q* – – –(3*c*)	*W* no. 36 ♂ *p* – – –(*Waβ*)	1*H*18a^3 ♀ *00p* – – –(*A* × 1)
	a^5 – *q* – – –(3*c*)	a^6 – *q* – – –(3*c*)	... ...	... ...	... ...	... ...
0*H* 150	a^1 ♂ *15 q*47. 1. 1(2*c*)	a^2 *55 q*47.47. 1(3*c*)	a^3 *35 q*47. 1. 1(2*c*)	a^4 – *q* – – –(2*c*)	*W* no. 31 ♂ *p* – – –(*Wβ*)	1*H*19a^6 ♀ *00p* – – –(*A* × 1)
	a^5 – *q* – – –(2*c*)	... ...	... ...	... ...	... ...	... ...
0*H* 151	a^1 ♂ *85 q*53.46. 2(5*c*)	a^2 ♂ *55 q*46. 1. 1(3*c*)	a^3 ♂ *30 q*53. 1. 1(2*c*)	a^4 ♂ *75 q*53.46. 1(4*c*)	*W* no. 35 ♂ *p* – – –(*Waβ*)	1*H*28b^3 ♀ *00p* – – –(*A* × 2)
	a^5 *80 q*53.51. 2(5*c*)	a^6 – *q* – – –(4*c*)	... ...	... ...	... ...	... ...
0*H* 152	a^1 ♂ *80 q*44.47. 2(5*d*)	a^2 ♂ – *q* – – –(5*c*)	a^3 ♀ – *q* – – –(5*c*)	a^4 ♀ – *q* – – –(5*c*)	*W* no. 35 ♂ *p* – – –(*Waβ*)	1*H*28b^4 ♀ *00p* – – –(*A* × 2)
	a^5 – *q* – – –(5*c*)	a^6 – *q* – – –(6*c*)	a^7 – *q* – – –(5*c*)	... ...	... ...	... ...
0*H* 153	a^1 ♀ *60 q*44.47. 1(3*c*)	a^2 ♂ *90 q*44.46.11(4*c*)	a^3 ♂ *95 q* 44.53. 2(4*d*)	a^4 – *q* – – –(4*c*)	*W* no. 35 ♂ *p* – – –(*Waβ*)	1*H*28b^5 ♀ *00p* – – –(*A* × 2)
	a^5 – *q* – – –(4*c*)	a^6 – *q* – – –(3*c*)	... ...	... ...	... ...	... ...
0*H* 154	a^1 ♀ *35 p*37. 1. 2(2*a–b*)	a^2 ♀ *35 q*49. 1. 1(2–3*c*)	a^3 ♂ *10 p*35. 1. 4(1–2*a–b*)	a^4 ♀ – *p* – – –(2*b*)	*W* no. 54 ♂ *p* – – –(*Wβ*)	1*H*58a^2 ♀ *00p* – – –(*A* × 2)
	a^5 – *q* – – –(3*c*)	... ...	... ...	... ...	... ...	... ...
0*H* 155	a^1 ♂ *100xq*35.35.30(5*a*)	a^2 ♀ *00 p* – – –(alb.)	a^3 ♀ *00 p* – – –(alb.)	... ...	1*H*42b^1 ♂ *p* – – –(3*a–bw*)	*A*58a^4 ♀ *00p* – – –(*A* × 3)
0*H* 156	a^1 ♂ *00 p* – – –(alb.)	a^2 ♂ *00 p* – – –(alb.)	a^3 ♀ *00 p* – – –(alb.)	a^4 ♀ *100zq*48.46.20(5*b–c*)	1*H*42b^1 ♂ *p* – – –(3*a–bw*)	*A*58a^5 ♀ *00p* – – –(*A* × 3)
0*H* 159	a^1 ♂ – *q* – – –(5*c*)	a^2 ♂ – *q* – – –(5*c*)	a^3 ♂ – *q* – – –(5*c*)	a^4 ♀ – *q* – – –(5*c*)	*W* no. 31 ♂ *p* – – –(*Wβ*)	*A*141a^3 ♀ *00p* – – –(*A*1½ ♀)
	a^5 ♀ *100zq*52.46. 7(5*c*)	a^6 ♀ *75 q*52.46. 4(5*c*)	... ...	... ...	... ...	... ...
0*H* 160	a^1 ♂ – *q* – – –(5*c*)	a^2 ♂ – *q* – – –(5*c*)	a^3 ♀ *100xq*49.46. 2(5*c*)	a^4 ♀ *100zq*49.46. 7(5*c*)	*W* no. 31 ♂ *p* – – –(*Wβ*)	*A*141a^4 ♀ *00p* – – –(*A*1½ ♀)
	a^5 ♀ *100zq*49.46. 7(5*c*)	... ...	... ...	... ... —	... ...	... ...
0*H* 161	a^1 ♂ – *q* – – –(5*c*)	a^2 ♂ *80 q*48.46. 7(5*c*)	a^3 ♂ – *q* – – –(5*c*)	a^4 ♀ – *q* – – –(5*c*)	*W* no. 56 ♂ *p* – – –(*Wβ*)	*A*182a^3 ♀ *00p* – – –(*A*1½ ♀)
	a^5 ♀ *100zq*49.46.12(5*c*)	a^6 ♀ – *q* – – –(5*c*)	... ...	... ...	... ...	... ...
0*H* 162	a^1 ♀ *100zq*49.46.11(5*c*)	a^2 ♂ *80 q*48.46. 7(5*c*)	a^3 – *q* – – –(5*c*)	a^4 – *q* – – –(5*c*)	*W* no. 56 ♂ *p* – – –(*Wβ*)	*A*182a^4 ♀ *00p* – – –(*A*1½ ♀)
	a^5 – *q* – – –(5*c*)	a^6 – *q* – – –(5*c*)	... ...	... ...	... ...	... ...
0*H* 163	a^1 ♂ *75 q*44.51.11(5*c*)	a^2 ♂ *80 q*44.51.11(5*c*)	a^3 ♀ *80 q*44.51.11(5*c*)	a^4 ♀ *95 q*44.51.14(5*c*)	*W* no. 56 ♂ *p* – – –(*Wβ*)	*A*182a^5 ♀ *00p* – – –(*A*1½ ♀)
	a^5 – *q* – – –(5*c*)	... ...	... ...	... ...	... ...	... ...

0*H* 165	a^1 70 q48.46. 2(4c)	a^2 – q– – –(5c)	a^3 – q– – –(5c)	a^4 – q– – –(5c)	*W* no. 37 ♂ p– – –(*Wβ*)	*A*143a^2 ♀ 00 p– – –(*A*2)
	a^5 – q– – –(5c)	a^6 – q– – –(5c)	a^7 – q– – –(5c)	... ...	... ...	... ...
0*H* 166	a^1♂ – q– – –(5c)	a^2♂ – q– – –(4–5c)	a^3♂ 55 q47.21.11(3–4c)	a^4♂ 95 q48.36.28(5c)	*W* no. 37 ♂ p– – –(*Wβ*)	*A*143a^3 ♀ 00 p– – –(*A*2)
	a^5♀ 100zq49.48. 7(5c)	... ...	... ...	... ...	... ...	... ...
0*H* 167	a^1 80 q49.46. 1(5c)	a^2 85 q49.46.11(5c)	a^3 – q– – –(5c)	a^4 – q– – –(4c)	*W* no. 37 ♂ p– – –(*Wβ*)	*A*143a^4 ♀ 00 p– – –(*A*2)
	a^5 – q– – –(4c)	... ...	... .	... ...	... ...	... ...
0*H* 169	a^1♀ – q– – –(6c–*d*)	a^2 – q– – –(4c)	—	... ...	*A*155a^1 or a^2♂ 00p– – –(*A*2)	*W* no. 24 ♀ p– – –(*Waβ*)
0*H* 170	a^1♂ 45 q48.46. 2(3c)	a^2♂ – q– – –(3c)	a^3♀ 100zq49.46.12(5c)	a^4♀ – q– – –(5c)	*W* no. 42 ♂ p– – –(*Waβ*)	*A*184a^5 ♀ 00 p– – –(*A* × 1)
	a^5♀ 90 q49.35. 2(4c)	... ...	... ...	... ...	... ...	... ...
0*H* 171	a^1 40 q49.46. 1(3c)	a^2 50 q48.46. 1(3c)	a^3 45 q49.46. 4(3c)	a^4 45 q49.36. 1(3c)	*W* no. 42 ♂ p– – –(*Waβ*)	*A*184a^6 ♀ 00 p– – –(*A* × 1)
	a^5 – q– – –(5c)	... ...	... ...	... ...	... ...	... ...
0*H* 172	a^1 – q– – –(4c)	a^2 – q– – –(4c)	a^3 – q– – –(4c)	a^4 – q– – –(5c)	*W* no. 42 ♂ p– – –(*Waβ*)	*A*184a^7 ♀ 00 p– – –(*A* × 1)
	a^5 – q– – –(5c)	a^6 – q– – –(5c)	a^7 – q– – –(5c)	a^8 – q– – –(5c)	... ...	... ...
0*H* 175	a^1 – q– – –(5c)	a^2 – q– – –(5c)	a^3 – q– – –(5c)	a^4 – q– – –(5c)	*W* no. 37 ♂ p– – –(*Wβ*)	*A*167a^5 ♀ 00 p– – –(*A* × 2)
	a^5 – q– – –(5c)	a^6 – q– – –(5c)	a^7 – q– – –(5c)	... ...	... ...	... ...
0*H* 176	a^1 – q– – –(5c)	a^2 – q– – –(5c)	a^3 – q– – –(5c)	a^4 – q– – –(5c)	*W* no. 37 ♂ p– – –(*Wβ*)	*A*167a^6 ♀ 00 p– – –(*A* × 2)
	a^5 – q– – –(5c)	a^6 – q– – –(5c)	a^7 – q– – –(5c)	... ...	... ...	... ...
0*H* 179	a^1 55 q49.36. 4(3c)	a^2 30 q47. 1. 4(3c)	a^3 55 q49.46. 2(3c)	a^4 – q– – –(3c)	*W* no. 42 ♂ p– – –(*Waβ*)	*A*163a^4 ♀ 00 p– – –(*A* × 2)
	a^5 – q– – –(5c)	a^6 – q– – –(5c)	a^7 – q– – –(5c)	a^8 – q– – –(5c)	... ...	... ...
0*H* 184	a^1 100zq49.46. 7(5c)	a^2 100zq49.46.12(5c)	a^3 – q– – –(5c)	a^4 – q– – –(5c)	*W* no. 37 ♂ p– – –(*Wβ*)	*A*154a^2 ♀ 00 p– – –(*A* × 2)
	a^5 – q– – –(5c)	a^6 – q– – –(5c)	a^7 – q– – –(3c)	a^8 – q– – –(5c)	... ...	... ...
	a^9 – q– – –(5c)	a^{10} – q– – –(5c)	... ...	... ...	... ...	... ...
0*H* 185	a^1 – q– – –(6c)	a^2 – q– – –(6c)	... ...	... ...	*W* no. 37 ♂ p– – –(*Wβ*)	*A*157a^1 ♀ 00 p– – –(*A*1)

1*H*1	a^1 – q– – –(5c)	a^2 – q– – –(5c)	a^3 – q– – –(5c)	a^4 – q– – –(5c)	0*H*1a^1 ♂ 45 q49.46. 2(2*d*)	*Bt* – ♀ 00 p– – –(*A*1 ?)
1*H*2	a^1♀ 00 p– – –(alb.)	a^2♂ 00 p– – –(alb.)	a^3♂ 00 p– – –(alb.)	a^4♂ 00 p– – –(alb.)	0*H*1a^2 ♂ 55 q49. 1. 1(3c)	*Bt* – ♀ 00 p– – –(*A*1 ?)
	a^5♂ 100zq48.46.11(4*d*)	a^6♂ 90 q57.55. 1(4e)	a^7♂ 100zq48.46.11(4*d*)	a^8♂ 100xq57.55.55(5*d*)	... ...	... ...
	a^9♂ 00 p– – –(alb.)	... ...	... ...	... ...	... ...	... ...
1*H*3	a^1 00 p– – –(alb.)	a^2♀ – q– – –(6*d*)	a^3♀ 100zq49.46. 7(6c)	a^4♀ 100zq46.36.20(5c)	0*H*1a^3 ♂ 45 q48. 1. 1(2c)	*Bt* – ♀ 00 p– – –(*A*1 ?)
	a^5♂ 80 q46.36. 5(5c)	a^6♂ 00 p– – –(alb.)	a^7♂ 00 p– – –(alb.)	a^8♂ 00 p– – –(alb.)	... ...	... ...
	a^9 – q– – –(5c)	a^{10} – q– – –(5c)	... ...	... ...	... ...	... ...
1*H*4	a^1♂ – q– – –(5*d*)	a^2♀ 00 p– – –(alb.)	a^3 – q– – –(6e)	a^4 – q– – –(5c)	0*H*8 (or 7) a^1♂ 100zq48.36. 7(5c)	*Bt* – ♀ 00 p– – –(*A*1 ?)
	a^5 00 p– – –(alb.)	... ...	... ...	... ...	... ...	... ...
1*H*5	a^1♀ 100zq49.46.47(6*d*)	a^2♀ 100zq48.46.47(6*d*)	a^3♂ 100zq49.46.47(6*d*)	a^4♂ – q– – –(6c)	0*H*8 (or 7) a^2♂ 100zq49.46. 7(5c)	*Bt* – ♀ 00 p– – –(*A*1 ?)
	a^5♂ 00 p– – –(alb.)	... ...	... ...	... ...	... ...	... ...
1*H*6	a^1♀ 00 p– – –(alb.)	a^2♀ 00 p– – –(alb.)	a^3♂ – q– – –(6*d*)	a^4♂ 100zq49.46.47(6*d*)	0*H*7a^1 ♂ 100zq49.46. 7(5c)	*Bt* – ♀ 00 p– – –(*A*1 ?)
1*H*7	a^1♂ 30 p24. 1. 1(2*fw*)	a^2♀ 40 p37. 1. 1(2*a*)	a^3♀ 35 q49. 1. 2(2*b*)	b^1♂ 50 q49.46. 2(3c)	0*H*9a^1 ♂ – q– – –(2c)	0*H*1a^4 ♀ – q– – –(1c)
	b^2♂ 40 p37.37. 4(2*b*)	b^3♀ 25 q49. 1. 2(2*d*)	b^4♀ 30 q49. 1. 2(2*d*)	b^5 – q– – –(2c)	... ...	... ...
1*H*8	a^1♀ – p– – –(3*b*)	a^2♀ – p– – –(4*a*)	a^3♀ – p– – –(4*a*)	a^4♀ – q– – –(3c)	0*H*7a^2 ♂ 45 q48. 1. 1(2c)	0*H*1a^5 ♀ – q– – –(1c)
1*H*9	a^1♀ 40 p37.36. 3(3*a*)	a^2♀ 40 q58. 1. 1(3c : *ew*)	a^3♀ 70 p42.50. 1(3*f*)	a^4♂ 55 q40. 1. 1(3*b*)	0*H*7a^3 ♂ 55 q49.46. 2(2–3c)	0*H*1a^6 ♀ – q– – –(3c)
	a^5♂ 40 q49.46. 1(3*b*–*c*)	... ...	... ...	... ...	... ...	... ...
1*H*11	a^1♂ 00 p– – –(alb.)	a^2♀ 00 p– – –(alb.)	a^3♀ 00 p– – –(alb.)	a^4♂ 00 p– – –(alb.)	0*H*20a^1 ♂ 55 q47.46. 1(3*d*)	*Bt* – ♀ 00 p– – –(*A*1 ?)
	a^5♂ 100xq58.58.55(6e)	a^6 00 p– – –(alb.)	... ...	... ...	... ...	... ...
1*H*12	a^1♀ 00 p– – –(alb.)	a^2 ♀ – q– – –(6e)	a^3 00 p– – –(alb.)	a^4 – q– – –(6e)	*Bt* – ♂ 00 p– – –(*A*1)	0*H*9a^2 ♀ 30 q46. 1. 1(2c)
	a^5 – q– – –(3c)	... ...	... ...	... ...	... ...	... ...
1*H*13	a^1♂ 00 p– – –(alb.)	a^2♂ 80 q48.46.11(5*d*)	a^3♂ 100xq58.58.55(6e)	... ...	*Bt* – ♂ 00 p– – –(*A*1)	0*H*8 (or 7) a^4♀ – q– – –(5c)
1*H*14	a^1♂ 00 p– – –(alb.)	a^3♂ 00 p– – –(alb.)	a^3♂ 00 p– – –(alb.)	a^4♂ 00 p– – –(alb.)	*Bt* – ♂ 00 p– – –(*A*1)	0*H*8 (or 7) a^5♀ 100zq49.46.12(5c)
	a^5♀ – q– – –(2e)	a^6 ♀ – q– – –(3e)	... ...	... ...	... ...	... ...

MATING	OFFSPRING				PARENTS: Father	PARENTS: Mother
1*H*15	a^1 ♂ *00 p– – –*(alb.)	a^2 ♂ *00 p– – –*(alb.)	a^3 ♂ *65 q33 33. 3*(3*a*)	a^4 ♀ *100zq 35.35.30*(6*a*)	0*H*8(or 7)a^2 ♂ *100zq 49.46.7*(5*c*)	*Bt* – ♀ *00 p– – –*(*A*1 ?)
	a^5 ♀ *45 q39. 1. 1*(3*a*)	a^6 ♀ *70 q61.58. 1*(3*e*)	a^7 ♀ *00 p– – –*(alb.)	a^8 ♀ *00 p– – –*(alb.)	... ...	... ...
1*H*16	a^1 ♂ *95 q41.50. 4*(4*g*)	a^3 ♂ *55 q58.55. 1*(3*e*)	a^3 ♂ *00 p– – –*(alb.)	a^1 ♂ *00 p– – –*(alb.)	0*H*7a^1 ♂ *100zq 49.46.7*(5*c*)	*Bt* – ♀ *00 p– – –*(*A*1 ?)
	a^5 ♂ *00 p– – –*(alb.)	a^6 ♀ *00 p– – –*(alb.)	a^7 ♀ *00 p– – –*(alb.)	... ...	... ...	... ...
1*H*17	a^1 ♂ *85 q49.46.11*(5–6*c–d*)	a^2 ♂ *00 p– – –*(alb.)	a^3 ♂ *00 p– – –*(a'lb.)	a^4 ♂ *45 q61. 1. 1*(3*d*)	0*H*8(or 7)a^1 ♂ *100zq 48.36.7*(5*c*)	*Bt* – ♀ *00 p– – –*(*A*1 ?)
	a^5 ♂ *80 q58.58.55*(3*e*)	... ...	... ...	... ...	... ...	... ...
1*H*18	a^1 *– q– – –*(3*c*)	a^2 ♀ *55 p37. 1. 1*(3*bw*)	a^3 ♀ *00 p– – –*(alb.)	a^4 ♂ *35 p40. 1. 1*(3*b*)	0*H*7a^2 ♂ *45 q48. 1.1*(2*c*)	0*H*9a^3 ♀ *45 q48.46. 1*(2*c*)
	a^5 *00 p– – –*(alb.)	a^6 *00 p– – –*(alb.)	a^7 *00 p– – –*(alb.)	... ...	... ...	... ...
1*H*19	a^1 *– c– – –*(2*cw*)	a^2 *– q– – –*(4*cw*)	a^3 ♀ *– q– – –*(2*c*)	a^4 ♀ *30 q49. 1. 1*(2*c*)	0*H*7a^3 ♂ *55 q49.46.2*(2–3*c*)	0*H*9a^4 ♀ *50 q49. 1. 1*(2*c*)
	a^5 ♀ *00 p– – –*(alb.)	a^6 ♀ *00 p– – –*(alb.)	b^1 ♀ *40 q58. 1. 1*(2*e*)	b^2 *40 p35. 1. 1*(2*b*)	... ...	... ...
1*H*20	a^1 ♀ *00 p– – –*(alb. *w*)	a^2 ♀ *00 p– – –*(alb.)	a^3 ♂ *45 q49. 1. 1*(3*cw*)	a^4 ♂ *– q– – –*(2*e*)	0*H*9a^1 ♂ *– q– – –*(2*c*)	0*H*6a^1 ♀ *– q– – –*(2*c*)
	a^5 ♂ *– p– – –*(2*f*)	a^6 *– q– – –*(2*cw*)	... ...	... ...	... ...	... ...
1*H*24	a^1 ♀ *00 p– – –*(alb.)	a^2 ♀ *100zq 49.46.47*(6*d*)	a^3 ♂ *00 p– – –*(alb.)	a^1 ♂ *00 p– – –*(alb.)	0*H*13a^2 ♂ *100zq 48.46.7*(5*c*)	*Bt* – ♀ *00 p– – –*(*A*1 ?)
	a^5 ♂ *95 q49.46. 2*(4*d*)	a^6 ♂ *90 q49.46. 4*(4*d*)	... ...	... ...	... ...	... ...
1*H*26	a^1 ♀ *100zq 49.46.11*(5*d*)	a^2 ♀ *00 p– – –*(alb.)	a^3 ♀ *– q– – –*(6*e*)	a^4 ♂ *100zq 46.46.11*(5*d*)	0*H*13a^4 ♂ *45 q52. 1.1*(3*c*)	*Bt* – ♀ *00 p– – –*(*A* × 1or 2)
1*H*27	a^1 ♀ *00 p– – –*(alb.)	a^2 ♀ *00 p– – –*(alb.)	a^3 ♂ *00 p– – –*(alb.)	a^4 ♂ *00 p– – –*(alb.)	*Bt* – ♂ *00 p– – –*(*A*1)	0*H*7a^5 ♀ *50 q48.36. 2*(3*c*)
	a^5 ♂ *00 p– – –*(alb.)	a^6 ♂ *100xq 58.58.57*(6*e*)	... ...	... ...	... ...	... ...
1*H*28	a^1 ♀ *100zq 49.46.47*(5–6*c–d*)	a^2 ♀ *100zq 49.48.43*(5*c*)	b^1 ♂ *– q– – –*(6*d*)	b^2 ♂ *100zq 48.34. 9*(5*d*)	*Bt* – ♂ *00 p– – –*(*A*1)	0*H*7a^6 ♀ *100zq 48.46.12*(5*c*)
	b^3 ♀ *00 p– – –*(alb.)	b^4 ♀ *00 p– – –*(alb.)	b^5 ♀ *00 p– – –*(alb.)	... ...	... ...	... ...
1*H*29	a^1 ♂ *00 p– – –*(alb.)	a^2 ♂ *60 q49.46. 1*(4*c*)	a^3 ♀ *– q– – –*(2*c*)	a^4 ♀ *55 q49 46. 2*(3*d*)	0*H*16a^1 ♂ *50 q47. 1.1*(3*c*)	0*H*9a^5 ♀ *25 q46. 1. 1*(2*c*)
	a^5 *– q– – –*(2*e*)	b^1 ♀ *50 q49. 1. 2*(2*cw*)	b^2 ♂ *50 p23. 1. 2*(3*f*)	b^3 ♂ *00 p– – –*(alb.)	... ...	... ...
1*H*30	a^1 ♂ *35 p23. 1. 1*(2*f*)	a^2 ♀ *100zq 48.21.43*(5*cw*)	a^3 ♀ *45 p36. 1. 1*(3*b*)	a^4 ♀ *45 p23. 1. 2*(2*f*)	0*H*12a^1 ♂ *– q– – –*(5*c*)	0*H*9a^6 ♀ *40 q49. 1. 1*(2*d*)
	a^5 ♀ *60 q49.46. 3*(3*d*)	a^6 *– q– – –*(2*dw*)	... ...	... ...	... ...	... ...
1*H*31	a^1 *00 p– – –*(alb.)	... ...	... ...	... ...	0*H*12a^2 ♂ *– q– – –*(5*c*)	*Bt* – ♀ *00 p– – –*(*A*1)
1*H*32	a^1 ♀ *00 p– – –*(alb.)	a^2 ♀ *00 p– – –*(alb.)	a^3 ♀ *100zq 49.46. 2*(4*c*)	a^4 ♀ *100xq 58.57.55*(6*e*)	*A*1a^3 ♂ *00 p– – –*(*A*2½)	0*H*7a^7 ♀ *– q– – –*(2*d*)
	a^5 ♀ *100zq 49.46. 4*(5–6*c*)	a^6 ♂ *00 p– – –*(alb.)	a^7 *– q– – –*(6*c*)	... ...	... ...	... ...
1*H*33	a^1 ♀ *00 p– – –*(alb.)	a^2 ♀ *00 p– – –*(alb.)	a^3 ♀ *00 p– – –*(alb.)	a^4 ♀ *100yq 58.58.55*(6*e*)	0*H*8(or 7)a^1 ♂ *100zq 48.36.7*(5*c*)	*Bt* – ♀ *00 p– – –*(*A*1 ?)
	a^3 ♂ *00 p– – –*(alb.)	a^6 ♂ *– q– – –*(6*e*)	a^7 *– q– – –*(6*e*).	a^8 *– q– – –*(6*e*)	... ...	... ...
1*H*34	b^1 ♂ *00 p– – –*(alb.)	b^2 ♂ *95 q48.46. 1*(5*c*)	b^3 ♂ *100yq 49.46.47*(5*e*)	b^4 ♀ *– q– – –*(6*d*)	*Bt* – ♂ *00 p– – –*(*A*1 ?)	0*H*16a^2 ♀ *50 q48.46. 1*(3*c*)
1*H*35	b^1 ♂ *100zq 49.46.14*(4*d*)	b^2 ♀ *100zq 49.46.43*(5*d*)	b^3 ♂ *100zq 48.46.43*(5*d*)	b^4 ♂ *100zq 48.46.12*(5*d*)	*Bt* – ♂ *00 p– – –*(*A*1 ?)	0*H*16a^3 ♀ *50 q48. 1. 1*(3*c*)
	b^5 ♀ *100zq 46.46.14*(5*d*)	b^6 ♂ *00 p– – –*(alb.)	... ...	... ...	... ...	... ...
1*H*36	a^1 ♂ *00 p– – –*(alb.)	a^2 ♀ *00 p– – –*(alb.)	a^3 ♀ *75 q48.46. 1*(3*c–d*)	a^4 ♀ *30 r37. 1. 1*(2*c*)	0*H*35a^1 ♂ *– q– – –*(2*c*)	0*H*16a^4 ♀ *55 q49.46. 1*(4*c*)
	a^5 ♀ *15 q?37. 1. 1*(1*aw*)	... ...	... ...	... ...	... ...	... ...
1*H*37	a^1 ♀ *65 q49.48. 1*(2*a*)	a^2 ♀ *– r– – –*(2*a*)	a^3 ♀ *– q– – –*(3*c–dw*)	a^4 ♂ *25 p40. 1. 1*(2*aw*)	0*H*35a^1 ♂ *– q– – –*(2*c*)	0*H*16a^5 ♀ *– q– – –*(4*c*)
	a^5 ♂ *25 q47. 1. 1*(2*c*)	... ...	... ...	... ...	... ...	... ...
1*H*38	a^1 ♂ *00 p– – –*(alb.)	a^2 ♀ *00 p– – –*(alb.)	a^3 ♀ *100zq 48.46.43*(5–6*d*)	a^4 ♀ *100zq 49.46. 9*(5–6*d*)	*Bt* – ♂ *00 p– – –*(*A*1)	0*H*20a^4 ♀ *45 q49. 1. 1*(2*d*)
1*H*39	a^1 ♀ *00 p– – –*(alb.)	a^2 ♀ *00 p– – –*(alb.)	a^3 ♂ *00 p– – –*(alb.)	a^4 ♂ *00 p– – –*(alb.)	*Bt* – ♂ *00 p– – –*(*A*1)	0*H*20a^5 ♀ *25 q49. 1. 1*(2*d*)
1*H*40	a^1 ♀ *00 p– – –*(alb.)	a^2 ♀ *00 p– – –*(alb.)	a^3 ♀ *100zy 35.33.29*(6*a*)	a^4 ♂ *00 p– – –*(alb.)	*Bt* – ♂ *00 p– – –*(*A*1 .)	0*H*12a^3 ♀ *– q– – –*(5*a*)
	a^5 ♂ *00 p– – –*(alb.)	a^6 ♂ *00 p– – –*(alb.)	a^7 *– q– – –*(6*a*)	... ...	... ...	... ...
1*H*41	a^1 ♀ *00 p– – –*(alb.)	a^2 ♂ *00 p– – –*(alb.)	a^3 ♂ *00 p– – –*(alb.)	a^4 ♂ *100xq 61.61.57*(6*e*)	*Bt* – ♂ *00 p– – –*(*A*1 ?)	0*H*12a^4 ♀ *– q– – –*(5*c*)
	a^5 ♂ *100zq 49.46.14*(5*c*)	... ...	... ...	... ...	... ...	... ...
1*H*42	a^1 ♂ *00 p– – –*(alb. *w*)	a^2 ♂ *90 p39.35. 4*(4*a*)	a^3 ♀ *45 q49. 1. 1*(3*c*)	a^4 ♀ *35 q46. 1. 2*(3*c*)	0*H*1a^2 ♂ *55 q49. 1.1*(3*c*)	0*H*12a^5 ♀ *– q– – –*(5*a*)
	b^1 ♂ *55 p35.33. 1*(3*a–bw*)	b^2 ♂ *65 q39. 1. 3*(4*a*)	b^3 ♂ *– q– – –*(1*cw*)	b^4 ♀ *100yq 35.33.30*(6*a*)	... ...	... ...
	b^5 ♂ *00 p– – –*(alb.)	... ...	... ...	... ...	... ...	... ...
1*H*43	a^1 ♀ *00 p– – –*(alb.)	a^2 *– q– – –*(6*e*)	a^3 *00 p– – –*(alb.)	a^4 ♂ *– q– – –*(6*e*)	0*H*9a^1 ♂ *– q– – –*(2*c*)	*Bt* – ♀ *00 p– – –*(*A*1 ?)

	a^5 ♂ *100zq*49.46.12(5*c–d*)	... ...	... ...	... ...	... ...																		
1*H*44	a^1 ♀ *00 p* – – – (alb.)	a^2 ♀ *00 p* – – – (alb.)	a^3 ♀ *100zq* 49.46. 9(5*c–d*)	a^4 ♀ *85 q*48.46. 1(4*c*)																			
	a^5 *45 q*49.48. 1(3*c*)	... ...	... ...	... ...																			
1*H*45	a^1 ♂ *100xq*58.58.55(6*e*)	a^2 ♂ *00 p* – – – (alb.)	a^3 ♂ *00 p* – – – (alb.)	a^4 *00 p* – – – (alb.)																			
1*H*46	a^1 – *q* – – – (3*c*)	a^2 – *q* – – – (3*c*)	a^3 – *q* – – – (3*c*)	a^4 *00 p* – – – (alb.)																			
	a^5 *00 p* – – – (alb.)	a^6 *00 p* – – – (alb.)	a^7 *00 p* – – – (alb.)	a^8 *00 p* – – – (alb.)																			
1*H*47	a^1 ♀ *00 p* – – – (alb.)	a^2 ♀ *00 p* – – – (alb.)	a^3 ♀ *00 p* – – – (alb.)	a^4 ♂ *00 p* – – – (alb.)																			
	a^5 ♂ *100xq*58.57.55(6*e*)	a^6 ♂ *100xq*58.57.55(6*e*)	... ...	... ...																			
1*H*48	a^1 ♀ *00 p* – – – (alb.)	a^2 ♂ *100xq*58.57.55(6*e*)	a^3 ♂ *00 p* – – – (alb.)	a^4 ♂ *00 p* – – – (alb.)																			
1*H*49	a^1 ♀ *00 p* – – – (alb.)	a^2 ♀ *100zq* 48.36. 7(6**g*)	a^3 ♂ *100xq*58.57.55(6*e*)	a^4 ♂ *00 p* – – – (alb.)																			
	a^5 ♂ *00 p* – – – (alb.)	b^1 ♂ *55 q*46. 1. 1(3*c*)	b^2 ♀ *100zq* 47.46.14(5*d*)	b^3 ♂ *00 p* – – – (alb.)																			
	b^4 ♂ *00 p* – – – (alb.)	b^5 ♀ – *q* – – – (6*e*)	... ...	... ...																			
1*H*51	a^1 ♂ *30 q*46. 1. 1(4*c*)	a^2 ♀ *55 q*48. 1. 3(4*c*)	a^3 ♀ *75 q*58. 1. 2(4*e*)	a^4 ♀ *00 p* – – – (alb.)																			
1*H*52	a^1 ♂ *100xq*57.38.19(6*e*)	a^2 ♂ *100xq*57.57.55(6*e*)	a^3 ♂ *00 p* – – – (alb.)	a^4 ♂ *00 p* – – – (alb.)																			
	a^5 ♂ *00 p* – – – (alb.)	... ...	... ...	... ...																			
1*H*55	a^1 *45 q*37.37. 1(3**a*)	a^2 ♀ *00 p* – – – (alb.)	a^3 ♂ *00 p* – – – (alb.)	a^4 ♂ *00 p* – – – (alb.)																			
	a^5 ♂ *00 p* – – – (alb.)	a^6 ♂ *100xq*41.41.50(6*g*)	... ...	... ...																			
1*H*56	a^1 ♂ – *q* – – – (4*e*)	a^2 ♀ *90 q*48.46.12(4*c*)	a^3 ♀ *100zq* 49.48.12(5–6*d*)	a^4 ♀ *00 p* – – – (alb.)																			
1*H*57	a^1 ♀ *90 q*48.46. 1(4*c*)	a^2 ♀ *100zq* 49.36.12(5–6*d*)	a^3 ♀ *00 p* – – – (alb.)	a^4 ♀ *00 p* – – – (alb.)																			
	a^5 ♀ *00 p* – – – (alb.)	a^6 *00 p* – – – (alb.)	a^7 ♂ *85 q*48.46. 1(4*c*)	a^8 ♂ *60 q*49.46. 1(4*c*)																			
1*H*58	a^1 ♀ *30 q*39. 1. 1(2*a*)	a^2 ♀ *00 p* – – – (alb.)	a^3 ♀ *00 p* – – – (alb.)	a^4 ♂ *00 p* – – – (alb.)																			
1*H*59	a^1 *00 p* – – – (alb.)	a^2 ♂ *100xq*58.58.55(6*e*)	a^3 ♂ *00 p* – – – (alb.)	a^4 ♀ *100zq* 48.46.12(5*c*)																			
	a^5 *00 p* – – – (alb.)	a^6 *00 p* – – – (alb.)	a^7 *00 p* – – – (alb.)	... ...																			
1*H*60	a^1 ♂ *100xq*57.57.55(6*e*)	a^2 ♂ *00 p* – – – (alb.)	a^3 ♂ *75 q*46.46. 4(4*c*)	a^4 ♂ *55 q*49.46. 2(4*c*)																			
	a^5 – *q* – – – (6*e*)	a^6 *00 p* – – – (alb.)	... ...	... ...																			
1*H*61	a^1 ♂ *00 p* – – – (alb.)	a^2 ♀ *100zq* 46.46.11(5*c*)	... ...	... ...																			
1*H*63	a^1 ♂ *45 q*41. 1. 1(2*g*)	a^2 ♀ *100xq*58.58.55(6*e*)	a^3 ♂ *00 p* – – – (alb.)	a^4 ♀ *100zq* 48.48.12(5*d*)																			
	a^5 ♂ *00 p* – – – (alb.)	... ...	... ...	... ...																			
1*H*64	a^1 ♂ – *q* – – – (2*e*)	a^2 ♀ *35 q*49. 1. 1(2*d*)	a^3 ♀ *00 p* – – – (alb.)	a^4 ♂ *00 p* – – – (alb.)																			
1*H*65	a^1 ♀ *100xq*58.58.55(6*e*)	a^2 ♀ *00 p* – – – (alb.)	a^3 ♂ *00 p* – – – (alb.)	a^4 ♂ *00 p* – – – (alb.)																			
	b^1 ♀ – *q* – – – (6*e*)	b^2 ♀ *100xq*58.58.56(6*e*)	b^3 ♀ *00 p* – – – (alb.)	... ...																			
1*H*66	a^1 ♂ – *q* – – – (3*e*)	a^2 ♂ *85 p*23.23. 1(4*f*)	a^3 ♀ *35 q*46. 1. 1(3*c*)	a^4 ♂ – *q* – – – (2*aw*)																			
	a^5 ♂ *20 q*47. 1. 1(1*c*)	a^6 ♂ – *p* – – – (2*f*)	... ...	... ...																			
1*H*67	a^1 *00 p* – – – (alb.)	a^2 – *q* – – – (3*c*)	... ...	... ...																			
1*H*68	a^1 ♀ – *q* – – – (1*e*)	a^2 ♀ *10 q*47. 1. 1(1*cw*)	a^3 – *q* – – – (1*cw*)	a^4 *00 p* – – – (alb. *w*)																			
	a^5 – *q* – – – (3*c*)	... ...	... ...	... ...																			
1*H*70	a^1 ♀ *45 q*58. 1. 2(3*e*)	a^2 ♂ *55 q*37.33.30(3*a*)	a^3 ♀ – *q* – – – (2*c*)	... ...																			
1*H*71	a^1 ♀ – *q* – – – (3*c*)	a^2 *00 p* – – – (alb.)	... ...	... ...																			
1*H*72	a^1 ♂ – *q* – – – (3*c*)	... ...	... ...	... ...																			
1*H*73	a^1 ♀ *70 q*48.46. 1(3*c*)	a^2 ♀ *100zq* 49.46.43(5*d*)	a^3 ♀ *100zq* 48.46.12(5*c*)	... ...																			
1*H*74	a^1 ♂ – *p* – – – (3*a*)	b^1 ♂ *35 p*23. 1. 1(2*a*)	b^2 ♀ *50 p*36.36. 2(3*a–b*)	... ...																			
1*H*75	a^1 *00 p* – – – (alb.)	... ...	... ...	... ...																			
1*H*76	a^1 ♀ *60 q*58.58. 1(3*e*)	a^2 *00 p* – – – (alb.)	a^3 *00 p* – – – (alb.)	... ...																			
1*H*77	a^1 ♂ – *q* – – – (4*e*)	... ...	... ...	... ...																			
1*H*78	a^1 ♂ – *q* – – – (3*c*)	a^2 ♂ *00 p* – – – (alb.)	... ...	... ...																			
1*H*80	a^1 ♂ *00 p* – – – (alb.)	a^2 ♀ *00 p* – – – (alb.)	a^3 ♂ *00 p* – – – (alb.)	a^4 ♂ *00 p* – – – (alb.)																			
	a^5 ♀ *00 p* – – – (alb.)	a^6 ♀ *100zq* 37.36. 4(5*g*)	a^7 ♂ *100xq*57.57.55(6*e*)	... ...																			
1*H*81	a^1 ♀ – *q* – – – (6*e*)	a^2 ♀ – *q* – – – (3*e*)	a^3 ♂ – *q* – – – (4*e*)	a^4 ♂ *00 p* – – – (alb.)																			
	a^5 ♀ *00 p* – – – (alb.)	a^6 ♀ *00 p* – – – (alb.)	a^7 ♂ *00 p* – – – (alb.)	a^8 ♀ – *q* – – – (6*e*)																			
	a^9 ♀ – *q* – – – (6*e*)	... ...	... ...	... ...																			

MATING	OFFSPRING				PARENTS	
					Father	Mother
1*H*83	b^1 ♂ *00 p* – – –(alb.)	b^2 ♀ – *q* – – –(5*e*)	b^3 ♀ – *q* – – –(5*e*)	b^4 ♂ – *q* – – –(6*e*)	*A*12a^6 ♂ *00 p* – – –(*A* × 2)	0*H*77a^6 ♀ *100xq*57.56.56(5*e*)
	b^5 ♀ *60 q* 61.60. 2(4*e*)	... ...	... ...	... ...	... ...	... ...
1*H*84	a^1 – *q* – – –(4*c* : *g*)	a^2 – *q* – – –(3*c* : *g*)	a^3 – *q* – – –(3*e*)	... ...	*A*14a^2 ♂ *00 p* – – –(*A*1)	0*H*77a^7 ♀ *70 q*61.61. 1(4*e*) 0*H*77a^8 ♀ – *q* – – –(5*c*)
1*H*85	b^1 ♀ *00 p* – – –(alb.)	b^2 ♀ *00 p* – – –(alb.)	b^3 ♀ *00 p* – – –(alb.)	b^4 ♂ *00 p* – – –(alb.)	*A*14a^2 ♂ *00 p* – – –(*A*1)	0*H*77a^8 ♀ – *q* – – –(5*c*)
	b^5 ♂ *00 p* – – –(alb.)	b^6 ♂ *00 p* – – –(alb.)	... ...	... ...	... ...	... ...
1*H*86	a^1 ♂ – *q* – – –(5*c*)	a^2 ♂ – *q* – – –(5*c*)	a^3 ♂ *00 p* – – –(alb.)	a^4 ♀ *00 p* – – –(alb.)	*A*12a^7 ♂ *00 p* – – –(*A* × 2)	0*H*84a^1 ♀ – *q* – – –(5*c*)
1*H*87	a^1 ♀ *100xq* 58.58.57(6*e*)	a^2 ♂ *00 p* – – –(alb.)	a^3 ♀ *00 p* – – –(alb.)	a^4 ♀ *00 p* – – –(alb.)	*A*12a^7 ♂ *00 p* – – –(*A* × 2)	0*H*84a^2 ♀ *100zq* 49.46. 4(5*c*)
	a^5 ♀ – *q* – – –(6*c*)	... ...	... ...	... ...	... ...	... ...
1*H*88	a^1 *00 p* – – –(alb.)	a^2 *00 p* – – –(alb.)	a^3 *00 p* – – –(alb.)	a^4 – *q* – – –(6*e*)	0*H*13a^1 ♂ *50 q*46.46. 1(3*c*)	*A*15a^1 ♀ *00 p* – – –(*A* × 3) *A*15a^2 ♀ *00 p* – – –(*A* × 3)
	a^5 – *q* – – –(5*c*)	a^6 – *q* – – –(5*c*)	b^1 ♂ *00 p* – – –(alb.)	b^2 ♀ *00 p* – – –(alb.)	... ...	... ...
	b^3 ♀ *00 p* – – –(alb.)	b^4 ♀ *00 p* – – –(alb.)	b^5 *00 p* – – –(alb.)	b^6 ♀ – *q* – – –(6*e*)	... ...	... ...
1*H*90	a^1 ♀ *00 p* – – –(alb.)	a^2 ♀ *00 p* – – –(alb.)	a^3 ♂ – *q* – – –(6*e*)	... ...	0*H*7a^1 ♂ *100zq*49.46. 7(5*c*)	1*H*6a^1 ♀ *00 p* – – –(alb.) 1*H*6a^2 ♀ *00 p* – – –(alb.)
1*H*92	a^1 ♀ *50 q* 49.46. 1(3*c*)	a^2 ♂ *60 q* 58. 1. 1(4*e*)	a^3 ♂ *100xq*57.57.55(6*e*)	a^4 ♂ *00 p* – – –(alb.)	0*H*73a^6 ♂ – *q* – – –(3*c*)	*A*1a^9 ♀ *00 p* – – –(*A*2 ??)
	a^6 ♂ *00 p* – – –(alb.)	a^6 ♀ *00 p* – – –(alb.)	... ...	... ...	... ...	... ...
1*H*94	a^1 ♀ – *q* – – –(5*dw*)	a^2 ♂ – *p* – – –(6*aw*)	a^3 ♀ *00 p* – – –(alb. *w*)	a^4 ♂ *00 p* – – –(alb.)	0*H*84a ? ♂ – *q* – – –(5 ?)	0*H*84a ? ♀ – *q* – – –(5 ?)
1*H*95	a^1 ♀ – *q* – – –(3*e*)	a^2 ♂ – *q* – – –(2*e*)	a^3 ♂ *100zp*37.35. 4(6**b*–*c*)	a^4 ♂ *100x* : *r* : *p* 41.41.50(6* *b*–*c*) or a^2	0*H*62a^1 ♂ – *q* – – –(2 or 3*c*)	0*H*62a^{3-6} ♀ – *q*48 or 49 (3 or 5*c*)
	a^5 ♂ *00 p* – – –(alb.*w*)	a^6 *00 p* – – –(alb.)	... ...	... ...	... ...	... ...
1*H*96	a^1 ♂ *100zq* 48.46. 4(5*c*)	a^2 ♂ *100zq* 35.33.28(5–6*b*)	a^3 ♀ *00 p* – – –(alb.)	a^4 ♀ *00 p* – – –(alb.)	0*H*84a^7 ♂ *100zq*35.33.28(5*a*)	0*H*12a^3 ♀ – *q* – – –(5*a*)
	b^1 ♀ *00 p* – – –(alb.)	b^2 ♀ – *p* – – –(5*aw*)	b^3 ♀ *100zp* 35.33.28(5*a*–*b*)	b^4 – *q* – – –(5*a*)	... ...	... ...
1*H*97	a^1 ♀ *100zq* 33.30.28(5–6*b*?)	b^1 ♀ *00 p* – – –(alb.)	b^2 *100zp* 37.35. 6(5*b*)	b^3 – *q* – – –(5*c*)	0*H*111a^2 ♂ – *q* – – –(5*a*)	0*H*12a^5 ♀ – *q* – – –(5*a*)
	b^4 – *p* – – –(3*b*)	... ...	... ...	... ...	... ...	... ...
1*H*98	a^1 ♂ – *q* – – –(4*e*)	a^2 ♂ *80 q*61.57. 1(4*e*)	a^3 ♂ *100zq* 49.46. 4(6*c*)	a^4 ♀ *100zq* 49.46.30(5*c*)	0*H*111a^1 ♂ – *q* – – –(5*d*)	0*H*7a^6 ♀ *100zq* 48.46.12(5*c*)
	a^6 ♀ *100zq* 48.46. 4(5–6*c*)	a^6 *85 p*26. 9. 3(5–6*b*)	a^7 *00 p* – – –(alb.)	b^1 *80 p*37.37. 2(5*b*)	... ...	... ...
	b^2 – *p* – – –(6*f*)	b^3 – *q* – – –(5*c*)	b^4 – *q* – – –(5*c*)	b^5 *00 p* – – –(alb.)	... ...	... ...
	b^6 *00 p* – – –(alb.)	... ...	... ...	... ...	... ...	... ...
1*H*99	a^1 ♂ *100zp* 39.35.28(6*b*)	a^2 – *q* – – –(5*c*)	a^3 ♂ *80 q*48.46. 7(5*d*)	a^4 *00 p* – – –(alb.)	0*H*84a^8 ♂ – *q* – – –(5*c*)	0*H*82a^2 ♀ – *q* – – –(5*c*)
1*H*100	a^1 ♀ *00 p* – – –(alb.*w*)	a^2 ♂ *30 q*46. 1. 1(2*c*)	a^3 ♂ – *q* – – –(2*d*)	a^4 ♀ *65 q*49.46. 1(3*c*–*d*)	0*H*13a^4 ♂ *45 q*52. 1. 1(3*c*)	0*H*82a^1 ♀ *55 q*48.46.12(3*c*)
	a^5 ♀ *30 p* 37. 1. 1(2*b*)	a^6 ♂ *85 p*36.36. 1(4*b*)	b^1 ♂ *55 q*49.46. 1(3*c*)	b^2 ♂ *60 q*55.46. 1(4*c*)	... ...	... ...
	b^3 ♂ *00 p* – – –(alb.)	b^4 ♀ *65 q*58.58. 4(4*e*)	b^5 ♀ *00 p* – – –(alb.)	b^6 ♀ *00 p* – – –(alb.)	... ...	... ...
1*H*101	a^1 *100xp* 24.24.17(6*f*)	a^2 ♂ *00 p* – – –(alb. *w*)	a^3 ♂ *65 q*61.60. 3(3*e*)	a^4 – *q* – – –(5*e*)	0*H*84a^9 ♂ *100zq* 48.46.28(5*c*)	0*H*85a^4 ♀ – *q* – – –(5–6*d*)
	a^5 ♀ – *q* – – –(6*e*)	a^7 *75* 49.46. 9	b^1 ♂ *00 p* – – –(alb.)	b^2 ♀ *100xq*49.48.46(6*c*)	... ...	... ...
	b^3 ♀ *100xq* 58.58.55(6*ew*)	b^4 ♂ *00 p* – – –(alb.)	b^5 ♀ *00 p* – – –(alb.)	b^6 ♀ – *p* – – –(6**b*–*g*)	... ...	... ...
1*H*102	a^1 ♂ *100zq* 52.51. 9(5*dw*)	a^2 – *p* – – –(5*bw*)	a^3 ♂ *100zq* 37.37. 4(5*b*–*c*)	a^4 ♀ *100xq*58.57.57(6*e*)	0*H*20a^3 ♂ *100zq* 48.46. 7(5*d*)	0*H*85a^3 ♀ – *q* – – –(5*d*)
	a^5 – *q* – – –(1*cw*)	a^6 *00 p* – – –(alb. *w*)	b^1 ♂ *25 p*37. 1. 1(1–2*b*)	b^2 ♂ – *p* – – –(6*f*)	... ...	... ...
	b^3 ♂ – *p* – – –(6*fw*)	b^4 ♀ *100xp*24.24.15(6*fw*)	b^5 – *q* – – –(3*c*)	... ...	... ...	... ...
1*H*103	a^1 ♀ *55 q* 34.34. 1(3*bw*)	a^2 – *p* – – –(3*bw*)	a^3 ♀ – *q* – – –(4*b*–*c*)	b^1 ♀ *60 dr*40.39.1(4*b*–*c*)	0*H*120a^4 ♂ *60 q*49.46. 1(3*c*)	0*H*85a^1 ♀ – *q* – – –(4*d*)
	b^2 ♀ *55 p* or *dr* 40.35. 1(4*b*)	b^3 ♀ *80 p*36.34. 3(4*b*)	b^4 ♀ *65 q*61.60. 1(3*e*)	b^5 – *q* – – –(3*b*)	... ...	... ...
	b^6 – *q* – – –(3*b*–*c*)	... ...	... ...	... ...	... ...	... ...
1*H*104	a^1 ♀ *00 p* – – –(alb.)	a^2 ♂ – *q* – – –(2*e*)	a^3 ♀ *50 p*37.36. 3(3*b*)	a^4 ♀ *00 p* – – –(alb.)	0*H*120a^7 ♂ *50 q*48.46. 3(3*c*)	0*H*120a^3 ♀ *45 q*49. 1. 1 (2*c*)
	a^5 – *q* – – –(2*cw*)	b^1 *35 q*46. 1. 1(2*cw*)	b^2 ♂ – *q* – – –(3*b*–*c*)	b^3 *20 xq*47. 1. 1(k*w*)	... ...	... ...

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MATING	OFFSPRING				PARENTS	
					Father	Mother
1*H*122	b^2 ♀ *70 q*49.46. 4(4*c*)	b^3 ♂ – *p* – – –(3*a–b*)	b^4 ♂ – *p* – – –(3*a–b*)	... ...	... ...	... ...
1*H*123	a^1 ♂ *80 q*48.51. 4(5*c*)	a^3 ♂ *00 p* – – –(alb.)	a^3 ♀ *00 p* – – –(alb.)	a^4 – *q* – – –(5*c*)	0*H*100a^3 ♂ – *q* – – –(5*c*)	0*H*100a^8 ♀ – *q* – – –(5*c*)
	b^1 ♂ *60 q*58.55. 1(3*e*)	b^2 ♂ – *q* – – –(6*e*)	b^3 ♂ *100xq*57.56.55(6*e*)	b^4 ♂ *80 q*46.46. 4(5*c–d*)	... ...	... ...
	b^5 ♂ *100zp*35.33.28(5–6*b*)	b^6 *40 q*44. 1. 1(3*c*)	... ...	... ...	... ...	... ...
1*H*124	a^1 ♂ – *q* – – –(3*e*)	a^2 ♀ *90 p*37.37. 2(5*b–c*)	a^3 ♂ – *q* – – –(6*e*)	a^4 ♀ – *q* – – –(4*c*)	0*H*100a^2 ♂ – *q* – – –(5*c*)	0*H*111a^3 ♀ – *q* – – –(5*d*)
	a^5 – *q* – – –(5*cw*)	b^1 ♀ *65 q*58. 1. 1(3–4*e*)	b^2 ♀ *00 p* – – –(alb.*w*)	b^3 ♂ *65 q*58.54. 2(4*e*)	... ...	... ...
	b^4 ♂ *85 p*37.37. 2(5*b*)	b^5 – *p* – – –(5*b*)	... ...	... ...	... ...	... ...
1*H*125	a^1 ♀ *85 q*53.51. 4(5*c*)	a^2 – *q* – – –(5*c*)	a^3 ♀ *80 q*39.39. 4(5*b–c*)	a^4 – *q* – – –(6*c*)	0*H*85a^5 ♂ – *q* – – –(5*d*)	0*H*100a^7 ♀ – *q* – – –(5*c*)
	a^5 – *q* – – –(5*c*)	a^6 – *p* – – –(5*bw*)	a^7 – *q* – – –(3*c*)	... ...	... ...	... ...
1*H*126	a^1 ♂ *00 p* – – –(alb.)	a^2 ♀ – *p* – – –(2*b*)	a^3 ♂ – *q* – – –(1*cw*)	a^4 ♀ – *q* – – –(2*c*)	0*H*112a^1 ♂ *30 q*49. 1. 1(2*c*)	0*H*45a^4 ♀ – *q* – – –(2*d*)
	a^5 ♂ – *q* – – –(3*c*)	a^6 – *p* – – –(2*b*)	a^7 – *q* – – –(1*ew*)	b^1 ♀ *25 p*37.37. 5(2–3*a–b*)	... ...	... ...
	b^2 ♂ – *q* – – –(1–2*ew*)	b^3 ♀ *20 q*49. 1. 1(2*c*)	b^4 ♂ *05 p*37. 1. 1(1*a*)	b^5 ♂ *00 p* – – –(alb.)	... ...	... ...
1*H*127	a^1 ♀ *00 p* – – –(alb.)	a^2 ♀ *100zq* 47.51.20(5*c*)	a^3 ♂ *100zq* 48.46. 9(5*c*)	a^4 ♀ – *q* – – –(5*e*)	0*H*112a^2 ♂ – *q* – – –(5*c*)	0*H*102a^6 ♀ – *q* – – –(5*c*)
	a^5 – *q* – – –(5*c*)	b^1 ♀ – *q* – – –(3*c*)	b^2 ♀ *85 p*37.36. 4(5-6*bw*)	b^3 ♀ *100xq*41.41.50(6*g*)	... ...	... ...
	b^4 ♂ – *p* – – –(5–6*b*)	b^5 ♂ – *p* – – –(5–6*b*)	... ...	... ...	... ...	... ...
1*H*128	a^1 *00 p* – – –(alb.*w*)	a^2 ♂ *00 p* – – –(alb.*w*)	a^3 ♂ *100xp*26.26.17(6*fw*)	a^4 ♂ *100zp*36.35.30(5*a–f*)	0*H*86a^2 ♂ *100zq*49.46.28(5*c*)	0*H*102a^5 ♀ – *q* – – –(5*c*)
	a^5 ♂ *100zp*37.35.30(4*a–f*)	a^6 ♀ – *q* – – –(4*e*)	a^7 *85 q*44.47. 2(5*cw*)	b^1 ♂ *100zp*35.35. 4(5–6*b*)	... ...	... ...
	b^2 ♀ *00 p* – – –(alb.)	... ...	... ...	... ...	... ...	... ...
1*H*129	a^1 – *q* – – –(5*c*)	a^2 ♂ – *q* – – –(6*e*)	a^3 ♀ *100xp*24.23.15(6*f*)	a^4 ♀ *100zp*39.35.30(5*b*)	0*H*86a^1 ♂ *100zq*49.46. 9(5*c*)	0*H*102a^7 ♀ *100zq* 49.46.14(5*c*)
	b^1 *20 q*46. 1. 1(1–2*c*)	b^2 *100zp*37.37. 4(5*bw*)	b^3 *95 q*52.46. 7(5*cw*)	b^4 *100xq*60.60.54(5*e*)	... ...	... ...
	b^5 *100xq*60.60.54(6*ew*)	b^6 *65 q*61. 1. 1(4*e*)	b^7 *00 p* – – –(alb.)	... ...	... ...	... ...
1*H*130	a^1 ♀ *50 q*61.60. 1(4*ew*)	a^2 ♂ *35 p*19.34. 3(3*bw*)	a^3 ♀ *05 q*47. 1. 2(1*cw*)	a^4 ♂ *00 p* – – –(alb.)	0*H*104a^4 ♂ *40 q*48.46. 2(3*c*)	0*H*94a^1 ♀ *60 q*49.46. 1(3*c*)
	a^5 ♀ *00 p* – – –(alb.)	b^1 ♂ *30 p*37. 1. 1(2*a–b*)	b^2 ♀ – *p* – – –(2*a–b*)	b^3 ♂ *35 p*39.35. 1(2*a–b*)	... ...	... ...
	b^4 ♂ *15 p*37. 1. 3(2*b*)	b^5 ♂ – *q* – – –(3–4*e*)	b^6 ♀ *00 p* – – –(alb.)	... ...	... ...	... ...
1*H*131	a^1 ♂ *45 q*49.46. 1(3*c*)	a^2 ♀ *00 p* – – –(alb.)	a^3 ♂ – *q* – – –(3*c*)	a^4 ♂ – *q* – – –(2*e*)	0*H*104a^3 ♂ *40 q*46. 1. 1(3*c*)	*A*43a^1 ♀ *00 p* – – –(*A*2 ?)
1*H*133	a^1 ♂ *00 p* – – –(alb.)	a^2 ♂ *45 q*61.60. 1(2*e*)	b^1 *00 p* – – –(alb.)	b^2 *00 p* – – –(alb.)	0*H*114a^6 ♂ – *q* – – –(5*c*)	0*H*114a^1 ♀ – *q* – – –(5*c*)
	b^3 *100zq* 40.40.34(5*c*)	b^4 – *q* – – –(5*c*)	b^5 – *q* – – –(5*c*)	... ...	... ...	... ...
1*H*134	a^1 ♂ *00 p* – – –(alb.)	a^2 ♂ *00 p* – – –(alb.*w*)	b^1 ♂ – *q* – – –(2*c*)	b^2 ♂ – *q* – – –(2*c*)	0*H*117a^6 ♂ *65 q*48.46. 3(3*c*)	0*H*114a^2 ♀ *35 q*49.46. 1(3*c*)
	b^3 ♂ – *q* – – –(2*c*)	b^4 ♂ *00 p* – – –(alb.)	... ...	... ...	... ...	... ...
1*H*135	a^1 ♀ *100zp*37.37. 2(5*b*?–*c*)	a^2 ♂ *30 q*60. 1. 1(2*e*)	a^3 *00 p* – – –(alb.*w*)	a^4 – *q* – – –(6*e*)	0*H*113a^7 ♂ – *q* – – –(5*c*)	0*H*113a^4 ♀ *100zq*49.46.12(5*c*)
	b^1 *80 q*53.51.14(5*dw*)	b^2 *00 p* – – –(alb.)	... ...	... ...	... ...	... ...
1*H*136	a^1 ♀ *100zq*48.46. 9(5*cw*)	a^2 ♀ *100zp* 33.33.28(5*a*)	a^3 ♀ – *q* – – –(5*a*)	a^4 ♀ *35 p*39. 1. 1(2*b*)	0*H*113a^8 ♂ – *q* – – –(5*c*)	0*H*84a^3 ♀ *100zq*35.33.30(5*a*)
	a^5 ♂ *35 q*49. 1. 3(2*c*)	b^1 ♀ *90 p*39.35. 2(4*a*)	b^2 ♀ *100zp*33.33.30(5–6*a*)	b^3 ♀ *100zp*37.35.28(5*b)	... ...	... ...
1*H*137	a^1 ♀ *60 r*48.48. 2(3*g**)	b^1 ♀ – *q* – – –(3*c–d*)	b^2 *00 p* – – –(alb.)	b^3 *00 p* – – –(alb.)	0*H*117a^7 ♂ *90 q*49.46. 9(4*c*)	0*H*113a^2 ♀ *50 q*49.46. 2(3*c*)
1*H*138	a^1 ♂ *100zq* 48.46.11(5*cw*)	a^2 – *q* – – –(5*c*)	a^3 – *q* – – –(3*c* ; *g*)	a^4 *00 p* – – –(alb.*w*)	0*H*107a^1 ♂ *100zq*49.46.20(5*c*)	0*H*113a^9 ♀ *100zq*49.36.20(5*c*)
	b^1 ♀ *85 p*39.35. 2(5*bw*)	b^2 ♀ *100xq*42.42.50(6*gw*)	b^3 ♂ *100zq* 49.47. 9(5*c*)	b^4 ♀ *00 p* – – –(alb.)	... ...	... ...
	b^5 – *p* – – –(5*b*)	... ...	... ...	... ...	... ...	... ...
1*H*139	a^1 ♀ *60 p*26.23. 2(3*fw*)	a^2 ♂ – *p* – – –(1–2*f*)	a^3 ♀ *00 p* – – –(alb.)	b^1 ♂ *100xq*58.57.55(6*e*)	0*H*107a^2 ♂ *55 q*61.57. 1(3*e*)	0*H*78a^1 ♀ – *q* – – –(5*e*)
	b^2 ♂ *00 p* – – –(alb.*w*)	... ...	... ...	... ...	... ...	... ...
1*H*140	a^1 *55 q*52.51. 1(3*c*)	a^2 *100zq* 52.51. 9(6*c*)	a^3 ♀ *00 p* – – –(alb.)	a^4 ♀ *00 p* – – –(alb.)	*A*26a^1 ♂ *00 p* – – –(*A*2 ?)	0*H*113a^5 ♀ *100zq*48.46.43(5*c*)
	a^5 ♂ *00 p* – – –(alb.)	a^6 *00 p* – – –(alb.)	... ...	... ...	... ...	... ...
1*H*142	a^1 ♀ *100xq*58.57.55(6*e*)	a^2 ♀ *00 p* – – –(alb.)	a^3 ♀ *00 p* – – –(alb.)	b^1 ♂ *80 q*48.46. 2(5*c*)	0*H*103a^1 ♂ – *q* – – –(5*c*)	0*H*111a^5 ♀ – *q* – – –(5*d*)
	b^2 ♀ *80 q*48.46. 3(5*c*)	b^3 ♀ *100xq*58.57.55(6*e*)	b^4 – *p* – – –(6*f*)	b^5 – *q* – – –(4*c*)	... ...	... ...
1*H*143	a^1 ♂ *100zq* 48.46. 2(5*c*)	a^2 ♀ *100zq* 47.51.12(6*c*)	a^3 ♀ *100zq* 51.46.14(6*c*)	a^4 ♂ *00 p* – – –(alb.)	0*H*103a^2 ♂ – *q* – – –(5*c*)	*A*43a^2 ♀ *00 p* – – –(*A*2 ?)
	a^6 ♀ *00 p* – – –(alb.)	a^6 ♀ *00 p* – – –(alb.)	b^1 ♀ *95 q*46.33. 1(4*c*)	b^2 ♂ *00 p* – – –(alb.)	... ...	... ...

	b^3 ♂ *100zq* 49.46.14(5*c*)	b^4 *00 p* – – – (alb.)	... ...	... ...	... ...	... ...
1*H*144	a^1 ♂ – *q* – – – (2*e*)	a^2 ♂ *00 p* – – – (alb.)	b^1 ♀ *00 p* – – – (alb.)	b^2 ♂ – *q* – – – (5*c*)	0*H*114a^4 ♂ *50 q*46.30. 5(3*c*)	*A*43a^3 ♀ *00 p* – – – (*A*2 ?)
	b^3 ♂ *00 p* – – – (alb.)	b^4 ♂ *00 p* – – – (alb.)	... ...	... ...	... ...	... ...
1*H*145	a^1 ♂ *00 p* – – – (alb.)	a^2 ♀ *00 p* – – – (alb.)	a^3 ♀ *00 p* – – – (alb.)	a^4 ♀ *00 p* – – – (alb.)	0*H*114a^5 ♂ *25 q*49. 1. 2(2*c*)	0*H*112a^5 ♀ *40 q*49. 1. 1(2*c*)
	a^5 ♂ *35 q*51. 1. 2(2*c*)	b^1 ♀ – *q* – – – (1*c*)	b^2 ♂ – *p* – – – (1*fw*)	b^3 ♀ *20 q*46. 1. 3(2*c*)	... ...	... ...
	b^4 ♂ *30 p*37. 1. 1(2*b*)	... ...	... ...	... ...	... ...	... ...
1*H*146	a^1 ♀ *100zq* 48.47. 9(5*c*)	a^2 ♀ *100xq* 48.51.47(6*c*)	a^3 ♀ *00 p* – – – (alb.)	a^4 ♀ *00 p* – – – (alb.)	*A*26a^3 ♂ *00 p* – – – (*A*2 ?)	0*H*112a^4 ♀ *35 q*46. 1. 1(2*c*)
	a^5 ♀ *00 p* – – – (alb.)	a^6 – *q* – – – (6*e*)	b^1 ♀ *100zq* 52.46.20(5*c–d*)	b^2 ♀ *100zq* 49.46.20(5*c*)	... ...	... ...
	b^3 ♀ *00 p* – – – (alb.)	b^4 ♂ *00 p* – – – (alb.)	b^5 – *q* – – – (5*c*)	... ...	... ...	... ...
1*H*147	a^1 ♀ *65 q*44. 3. 3(3*c*)	a^3 ♀ *00 p* – – – (alb.)	a^3 ♀ *00 p* – – – (alb.)	a^4 ♀ *00 p* – – – (alb.)	*A*33a^1 ♂ *00 p* – – – (*A*2 ?)	0*H*112a^3 ♀ *50 q*48.46. 1(3*c*)
	a^5 ♂ *00 p* – – – (alb.)	... ...	... ...	... ...	... ...	... ...
1*H*148	a^1 ♂ *100xq* 58.58.55(6*e*)	a^2 ♂ *80 q*49.46. 4(5*c*)	a^3 ♀ *100zq* 48.46. 4(5*c*)	a^4 ♀ *00 p* – – – (alb.)	0*H*103a^3 ♂ – *q* – – – (5*c*)	0*H*111a^6 ♀ – *q* – – – (5*d*)
	a^5 *80 q*49.48. 3(5*c*)	a^6 ♀ *00 p* – – – (alb.)	b^1 ♂ – *p* – – – (4*f*)	b^2 ♂ *00 p* – – – (alb.)	... ...	... ...
	b^3 ♀ – *q* – – – (5*c*)	b^4 ♀ *00 p* – – – (alb.)	b^5 ♂ *00 p* – – – (alb. *w*)	... ...	... ...	... ...
1*H*149	a^1 ♂ – *q* – – – (5–6*c*)	a^2 ♀ *00 p* – – – (alb.)	a^3 ♀ *00 p* – – – (alb.)	a^4 ♀ *00 p* – – – (alb.)	*A*46a^2 ♂ *00 p* – – – (*A*2 ?)	0*H*111a^4 ♀ – *q* – – – (5*d*)
	a^5 ♂ *00 p* – – – (alb.)	a^6 – *q* – – – (5*c*)	b^1 ♂ *00 p* – – – (alb.)	b^2 ♂ *00 p* – – – (alb.)	... ...	... ...
	b^3 ♂ *100zq* 49.46.20(5*d*)	b^4 ♂ – *q* – – – (6*d*)	b^5 ♀ *00 p* – – – (alb.)	b^6 ♀ *100zq* 49.48.12(5*d*)	... ...	... ...
1*H*150	a^1 ♂ – *q* – – – (4*cw*)	a^2 ♂ *100zq* 48.46. 7(4*c*)	a^3 – *q* – – – (5*c*)	b^1 ♂ – *q* – – – (4*c*)	0*H*90a^2 ♂ – *q* – – – (5*c*)	0*H*117a^4 ♀ *90 q*49.36. 1(4*c*)
	b^2 ♂ – *q* – – – (*w*)	b^3 ♀ – *q* – – – (5*c*)	... ...	... ...	... ...	... ...
1*H*151	a^1 ♀ *100zq* 49.48.34(5*c*)	a^2 ♀ – *q* – – – (6*c*)	a^3 ♀ – *q* – – – (6*c*)	a^4 ♀ *80 q*49.48.34(5*c*)	*A*46a^3 ♂ *00 p* – – – (*A*2 ?)	0*H*117a^5 ♀ *65 q*49.36. 4(3*c*)
	a^5 ♂ *00 p* – – – (alb.)	b^1 ♀ *100zq* 49.48.47(6*c*)	b^2 ♀ – *q* – – – (5*c*)	b^3 ♀ *00 p* – – – (alb.)	... ...	... ...
	b^4 ♂ *00 p* – – – (alb.)	b^5 ♂ *00 p* – – – (alb.)	... ...	... ...	... ...	... ...
1*H*152	a^1 ♀ *100zq* 49.48.47(6*c*)	a^2 ♀ *00 p* – – – (alb.)	a^3 ♀ *00 p* – – – (alb.)	a^4 ♂ *00 p* – – – (alb.)	*A*46a^1 ♂ *00 p* – – – (*A*2 ?)	0*H*103a^4 ♀ *55 q*49. 1. 3(3*c*)
	a^6 ♀ *00 p* – – – (alb.)	a^6 ♂ *00 p* – – – (alb.)	c^1 ♂ *00 p* – – – (alb.)	c^2 ♀ *00 p* – – – (alb.)	... ...	... ...
	c^3 ♀ *00 p* – – – (alb.)	c^4 ♀ *00 p* – – – (alb.)	c^5 ♂ *80 q*48.46. 4(5*c*)	c^6 ♂ – *q* – – – (5*c*)	... ...	... ...
1*H*153	a^1 ♂ *75 q*40.34. 1(4*b–c*)	a^2 ♀ *75 q*61.60. 1(3*e*)	a^3 ♂ *00 p* – – – (alb.)	a^4 ♂ *00 p* – – – (alb.)	*A*25a^3 ♂ *00 p* – – – (*A*2 ??)	0*H*103a^5 ♀ *55 q*49.46. 4(3*c*)
	a^5 *00 p* – – – (alb.)	... ...	... ...	... ...	... ...	... ...
1*H*154	a^1 ♀ *100xq* 58.58.55(6*e*)	a^2 ♂ – *q* – – – (6*e*)	a^3 ♂ – *q* – – – (5*b–c*)	a^4 ♂ *00 p* – – – (alb.)	*A*25a^4 ♂ *00 p* – – – (*A*2 ??)	0*H*103a^6 ♀ *50 q*49.46. 3(3*c*)
	a^5 ♀ *00 p* – – – (alb.)	... ...	... ...	... ...	... ...	... ...
1*H*155	a^1 ♂ *90 q* 52.46. 1(4*c*)	a^2 ♂ *85 q*49.46. 4(5*c*)	a^3 ♂ *00 p* – – – (alb.)	a^4 ♂ *00 p* – – – (alb.)	*A*32a^7 ♂ *00 p* – – – (*A*2 ?)	0*H*100a^5 ♀ *25 q*46. 1. 1(2*c*)
	a^5 – *q* – – – (6*e*)	a^6 – *q* – – – (4*c*)	... ...	... ...	... ...	... ...
1*H*156	a^1 ♀ *100xq* 58.57.55(6*e*)	a^2 ♀ *00 p* – – – (alb.)	a^3 ♀ *00 p* – – – (alb.)	a^4 ♂ *00 p* – – – (alb.)	*A*32a^8 ♂ *00 p* – – – (*A*2 ?)	0*H*100a^6 ♀ *55 q*49.46. 9(3*c*)
1*H*157	a^1 ♀ – *q* – – – (5*a*)	a^2 ♀ – *q* – – – (5*a*)	a^3 ♀ *100zq* 49.48.14(5*d*)	a^4 ♀ *00 p* – – – (alb.)	*A*48a^4 ♂ *00 p* – – – (*A*2 ??)	0*H*84a^4 ♀ *100zq*35.33.30(5*a*)
	a^5 ♂ *00 p* – – – (alb.)	a^6 ♂ *00 p* – – – (alb.)	... ...	... ...	... ...	... ...
1*H*158	a^1 ♂ – *q* – – – (5*c*)	a^2 ♀ *100zq* 49.48. 9(5*c–d*)	a^3 ♀ *100zq* 49.48.34(5*c*)	a^4 ♀ *00 p* – – – (alb.)	*A*81a^2 ♂ *00 p* – – – (*A*2 ??)	0*H*84a^5 ♀ *100zq*33.30.28(5*a*)
	a^5 *00 p* – – – (alb.)	a^6 *00 p* – – – (alb.)	b^1 ♂ *100zq* 46.46. 9(5*c*)	b^2 ♂ *00 p* – – – (alb.)	... ...	... ...
	b^3 ♂ *100zq* 33.33. 4(5*a*)	b^4 ♀ *100zq* 35.30.28(5*a*)	b^5 ♀ *100zq* 49.48.14(5*c*)	b^6 ♀ – *q* – – – (5*c*)	... ...	... ...
1*H*159	a^1 ♀ – *q* – – – (5*c*)	a^2 ♀ *00 p* – – – (alb.)	a^3 ♂ *00 p* – – – (alb.)	... ...	*A*81a^3 ♂ *00 p* – – – (*A*2 ??)	0*H*84a^6 ♀ *100zq*39.33.30(5*a*)
1*H*160	a^1 *00 p* – – – (alb.)	a^2 *00 p* – – – (alb.)	a^3 – *q* – – – (5*c*)	a^4 – *q* – – – (5*c*)	*A*93a^2 ♂ *00 p* – – – (*A*2 ×)	0*H*111a^7 ♀ – *q* – – – (5*a*)
	a^6 – *q* – – – (5*c*)	a^6 – *q* – – – (5*c*)	... ...	... ...	... ...	... ...
1*H*161	a^1 ♂ *100zq* 35.33.28(5*a–b*)	a^2 ♂ *100zq* 48.46. 7(5*c*)	a^3 ♀ *100zq* 49.48. 9(5*c*)	a^4 ♂ *00 p* – – – (alb.)	*A*28a^1 ♂ *00 p* – – – (*A*2 ?)	0*H*111a^8 ♀ *100zq*35.35.30(5*a*)
	a^5 ♂ *00 p* – – – (alb.)	a^6 ♂	... ...	... ...	... ...	... ...
1*H*162	a^1 ♀ – *q* – – – (5*c*)	a^2 ♂ – *q* – – – (5*a–b*)	a^3 ♀ *00 p* – – – (alb.)	... ...	*A*34a^1 ♂ *00 p* – – – (*A* × 3)	0*H*111a^9 ♀ *100zq*35.34.29(5*a*)
1*H*163	a^1 ♂ – *q* – – – (5*a–b*)	a^3 ♂ – *q* – – – (5*a*)	a^3 ♀ – *q* – – – (4*c*)	a^4 ♂ – *q* – – – (4*c*)	*A*81a^4 ♂ *00 p* – – – (*A*2 ??)	0*H*111a^{10} ♀ – *q* – – – (5*a*)
1*H*164	a^1 ♂ *100xq* 58.58.55(6*e*)	a^3 ♂ *100zq* 36.36. 9(5*c*)	a^3 ♂ *00 p* – – – (alb.)	b^1 ♀ – *q* – – – (6*e*)	0*H*120a^4 ♂ *60 q*49.46. 1(3*c*)	*A*133a^1 ♀ *00 p* – – – (*A* × 2)
	b^2 ♂ – *q* – – – (6*e*)	b^3 ♂ *00 p* – – – (alb.)	b^4 ♀ *00 p* – – – (alb.)	b^5 ♀ *00 p* – – – (alb.)	... ...	... ...
	b^6 ♀ *00 p* – – – (alb.)	b^7 ♂ *00 p* – – – (alb.)	... ...	... ...	... ...	... ...
1*H*165	a^1 ♂ *80 q*49.36.11(5*c*)	a^2 ♂ *00 p* – – – (alb.)	... ...	... ...	0*H*101a^2 ♂ *50 q*49.46. 4(3*c*)	*A*133a^2 ♀ *00 p* – – – (*A* × 2)
1*H*166	a^1 ♂ *00 p* – – – (alb.)	a^2 ♂ *00 p* – – – (alb.)	a^3 ♂ *00 p* – – – (alb.)	a^4 ♂ – *q* – – – (5*c*)	0*H*120a^1 ♂ – *q* – – – (4*c*)	*A*133a^3 ♀ *00 p* – – – (*A* × 2)
	a^5 ♂ – *q* – – – (5*c*)	a^6 ♂ *00 p* – – – (alb.)	a^7 ♀ *00 p* – – – (alb.)	a^8 – *q* – – – (5*d*)	... ...	... ...

MATING	OFFSPRING				PARENTS	
					Father	Mother
1*H*167	a^1♀ – *q* – – –(5*c*–*d*)	a^2♀ *100xq*58.58.55(6*e*)	a^3♀ *100zq* 49.46.21(6*c*)	a^4♂ *100zq* 48.46.47(6*c*)	0*H*13a^4 ♂ *45 q*52. 1. 1(3*c*)	*A*133a^4 ♀ *00 p* – – –(*A* × 2)
	a^5♂ *100zq* 48.46.12(6*d*)	a^6♂ *00 p* – – –(alb.)	a^7♀ *00 p* – – –(alb.)	a^8♂ *00 p* – – –(alb.)	... ...	... ...
1*H*168	a^1♂ *00 p* – – –(alb.)	a^2♂ *00 p* – – –(alb.)	a^3♂ *100zq* 39.33.28(4*a*)	a^4♀ *00 p* – – –(alb.)	*A*133a^6 ♂ *00 p* – – –(*A* × 2)	0*H*84a^4 ♀ *100zq* 35.33.30(5*a*)
	a^5♂ *100zq* 46.46. 9(5–6*c*)	a^6♀ *100zq* 33.33.28(5*a*)	a^7♀ *100zq* 35.30.28(5*a*)	... ...	... ...	... ...
1*H*169	a^1♂ *00 p* – – –(alb.)	a^2♂ *00 p* – – –(alb.)	a^3♂ *100xq*58.58.55(6*e*)	a^4♀ *100zq* 49.48.47(5*c*–*d*)	*A*133a^7 ♂ *00 p* – – –(*A* × 2)	0*H*112a^3♀ *50 q*48.46. 1(3*c*)
	a^5♂ *80 q*46.21. 7(5*c*)	a^6♀ *100zq* 48.46. 4(6*c*)	a^7♂ *00 p* – – –(alb.)	a^8♀ – *q* – – –(3–4*c*)	... ...	... ...
1*H*170	a^1♀ *00 p* – – –(alb.)	a^2♂ *85 q*48.51. 2(5*c*–*d*)	a^3♂ *00 p* – – –(alb.)	a^4♀ *100xq*26.26.26(6*g*)	0*H*101a^4♂ – *q* – – –(5*c*)	*A*136a^1 ♀ *00 p* – – –(*A* × 1)
	a^5♀ *85 q*40.40. 4(5*c*)	... ...	... ...	... ...	... ...	... ...
1*H*171	a^1♂ *100zq* 52.48.47(6*c*–*d*)	a^2♀ *00 p* – – –(alb.)	a^3♀ – *q* – – –(6*c*–*d*)	a^4♀ – *q* – – –(6*c*–*d*)	*A*136a^4 ♂ *00 p* – – –(*A* × 1)	0*H*118a^2♀ – *q* – – –(5*c*)
	a^5♀ *00 p* – – –(alb.)	... ...	... ...	... ...	... ...	... ...
1*H*172	a^1♀ *00 p* – – –(alb.)	a^2♀ *100xq*60.60.45(6*e*)	a^3♂ *00 p* – – –(alb.)	a^4 – *q* – – –(3-4*c*:*e*)	*A*133a^6 ♂ *00 p* – – –(*A* × 2)	0*H*1a^6 ♀ – *q* – – –(3*c*)
	a^6♂ – *q* – – –(4*c*)	... ...	... ...	... ...	... ...	... ...
1*H*173	a^1♂ *00 p* – – –(alb.)	a^2♂ *00 p* – – –(alb.)	a^3♀ *00 p* – – –(alb.)	a^4♀ – *q* – – –(6*e*)	*A*179a^1 ♂ *00 p* – – –(*A*2 ×)	0*H*62a^4 ♀ *100zq* 49.46. 7(5*c*)
	a^5♂ *100xq*57.57.55(6*e*)	a^6♀ *100zq* 47.51. 9(5*c*)	... ...	... ...	... ...	... ...
1*H*175	a^1♀ *00 p* – – –(alb.)	a^2♀ *00 p* – – –(alb.)	a^3♀ *100zq* 47.51.25(5*d*)	a^4♀ *100zq* 51.51. 7(5*c*)	*A*179a^3 ♂ *00 p* – – –(*A*2 ×)	0*H*102a^5♀ – *q* – – –(5*c*)
	a^5♂ *100zq* 40.36. 4(5*b*–*c*)	a^6♂ *100zq* 40.36. 9(5*b*–*c*)	a^7♂ – *q* – – –(4*e*)	... ...	... ...	... ...
1*H*178	a^1♀ *00 p* – – –(alb.)	a^2♀ *00 p* – – –(alb.)	a^3♂ *00 p* – – –(alb).	a^4♂ *00 p* – – –(alb.)	*A*150a^2 ♂ *00 p* – – –(*A*1 or 2)	0*H*113a^4♀ *100zq* 49.46.12(5*c*)
	a^5♂ *00 p* – – –(alb.)	a^6♀ *100xq*51.51.47(5–6*c*)	a^7♀ *80 q* 51.51. 2(5*c*)	a^8♀ – *q* – – –(2–3*c*)	... ...	... ...
1*H*179	a^1♀ *00 p* – – –(alb.)	a^2♀ *100xq*51.51.47(6*d*)	a^3♂ *100zq* 48.46. 7(5*c*)	a^4♂ *100zq* 52.47. 9(5*d*)	*A*150a^3 ♂ *00 p* – – –(*A*1 or 2)	0*H*7a^6 ♀ *100zq* 48.46.12(5*c*)
	a^5♀ – *q* – – –(5*c*)	a^6♂ – *q* – – –(5*c*)	... ...	... ...	... ...	... ...
1*H*180	a^1♂ *00 p* – – –(alb.)	a^2♂ *00 p* – – –(alb.)	a^3♀ *100zq* 51.51. 4(5*c*)	a^4♀ *100zq* 51.46. 9(5*c*)	*A*150a^4 ♂ *00 p* – – –(*A*1 or 2)	0*H*111a^3♀ – *q* – – –(5*d*)
	a^5♀ *100zq* 51.51. 9(5*c*)	a^6♀ *100zq* 52.51. 9(5*c*)	a^7♀ *100xq*51.47.47(6*c*)	... ...	... ...	... ...
1*H*181	a^1♂ *00 p* – – –(alb.)	a^2♂ *00 p* – – –(alb.)	a^3♂ *00 p* – – –(alb.)	a^4♂ *95 q*58.57. 1(5*e*)	*A*150a^5 ♂ *00 p* – – –(*A*1 or 2)	0*H*113a^6♀ *100zq* 49.36.20(5*c*)
	a^5♂ – *q* – – –(6*e*)	a^6♂ *80 q*52.51. 4(5*c*)	... ...	... ...	... ...	... ...
1*H*182	a^1♀ – *q* – – –(6*e*)	a^2♂ *00 p* – – –(alb.)	a^3♀ *00 p* – – –(alb.)	a^4♂ *00 p* – – –(alb.)	*A*153a^1 ♂ *00 p* – – –(*A*1 or 2)	0*H*111a^5♀ – *q* – – –(5*d*)
	a^5♂ *85 q*52.51. 4(5*c*)	a^6♂ *100zq* 52.51.34(5*c*)	... ...	... ...	... ...	... ...
1*H*183	a^1♀ *75 q*51.25. 2(5*c*)	a^2♂ *80 q*52.51. 7(5*c*)	a^3♂ *00 p* – – –(alb.)	a^4♀ *00 p* – – –(alb.)	*A*153a^2 ♂ *00 p* – – –(*A*1 or 2)	0*H*100a^8♀ – *q* – – –(5*c*)
	a^5♀ *00 p* – – –(alb.)	a^6♂ *00 p* – – –(alb.)	... ...	... ...	... ...	... ...
1*H*184	a^1♂ *00 p* – – –(alb.)	a^2♀ *00 p* – – –(alb.)	a^3♀ *00 p* – – –(alb.)	a^4♀ *00 p* – – –(alb.)	*A*153a^3 ♂ *00 p* – – –(*A*1 or 2)	0*H*102a^6♀ – *q* – – –(5*c*)
	a^5♀ *00 p* – – –(alb.)	a^6♀ *00 p* – – –(alb.)	a^7♀ *00 p* – – –(alb.)	a^8 *00 p* – – –(alb.)	... ...	... ...
	a^9 – *q* – – –(6*e*)	... ...	... ...	... ...	... ...	... ...
1*H*185	a^1♀ – *q* – – –(4*e*)	a^2♀ – *q* – – –(6*e*)	a^3♀ – *q* – – –(6*e*)	a^4♂ – *q* – – –(6*e*)	*A*153a^4 ♂ *00 p* – – –(*A*1 or 2)	0*H*61a^7 ♀ – *q* – – –(5*c*)
	a^5♂ – *q* – – –(6*e*)	a^6♂ *00 p* – – –(alb.)	a^7♂ *00 p* – – –(alb.)	a^8 – *q* – – –(6*e*)	... ...	... ...
	a^9 – *q* – – –(5*c*)	... ...	... ...	... ...	... ...	... ...
1*H*186	a^1♀ *00 p* – – –(alb.)	a^2♀ *00 p* – – –(alb.)	a^3♀ *00 p* – – –(alb.)	a^4♂ *00 p* – – –(alb.)	0*H*100a^4♂ *100zq* 49.46. 7(5*c*)	*A*147a^4 ♀ *00 p* – – –(*A*2 ×)
	a^5♀ *00 p* – – –(alb.)	a^6♂ *00 p* – – –(alb.)	a^7♂ *100zq* 52.47.12(5*d*)	a^8♀ *95* q52.46.12(5*c*)	... ...	... ...
1*H*187	b^1♀ *55* q58.57. 1(3*e*)	b^2 *60* q48.46. 1(3*c*)	b^3 *00 p* – – –(alb.)	... ...	0*H*59a^2 ♂ *100zq* 49.46. 7(6*d*)	*A*147a^5 ♀ *00 p* – – –(*A*2 ×)
1*H*188	a^1♂ – *q* – – –(5*e*)	a^2♂ *100xq*41.50.26(5–6*g*)	... ...	... ...	0*H*107a^1♂ *100zq* 49.46.20(5*c*)	*A*147a^6 ♀ *00 p* – – –(*A*2 ×)
1*H*189	a^1♂ *00 p* – – –(alb.)	a^2♀ *00 p* – – –(alb.)	a^3♀ *00 p* – – –(alb.)	a^4♂ – *q* – – –(6*e*)	0*H*103a^3♂ – *q* – – –(5*c*)	*A*147a^7 ♀ *00 p* – – –(*A*2 ×)
	a^5♂ *100zq* 52.51.43(5–6*c*)	a^6♀ *30* q47.47. 1(2*c*–*d*)	a^7♀ – *q* – – –(3*e*)	... ...	... ...	... ...
1*H*190	a^1♀ *85* q61.60. 1(3–4*e*)	a^2♂ *100xq*58.57.57(6*e*)	a^3♂ – *q* – – –(6*e*)	a^4♂ – *q* – – –(6*e*)	0*H*100a^2♂ – *q* – – –(5*c*)	*A*152a^4 ♀ *00 p* – – –(*A*1 or 2)
	a^5♀ *90* q52.46.14(5*c*)	... ...	... ...	... ...	... ...	... ...
1*H*191	a^1♀ *00 p* – – –(alb.)	a^2♀ *00 p* – – –(alb.)	a^3♀ – *q* – – –(6*e*)	a^4♀ – *q* – – –(6*e*)	0*H*101a^3♂ – *q* – – –(5*c*)	*A*152a^5 ♀ *00 p* – – –(*A*1 or 2)
	a^5♂ *70* q49.51. 1(3*c*)	... ...	... ...	... ...	... ...	... ...
1*H*192	a^1 *00 p* – – –(alb.)	a^2 *00 p* – – –(alb.)	a^3 *90* q48.46.14(5*c*)	a^4 *100zq* 52.46.12(5*d*)	0*H*103a^1♂ – *q* – – –(5*c*)	*A*152a^6 ♀ *00 p* – – –(*A*1 or 2)
	a^5 *100zq* 55.46.43(6*e*)	a^6♂ – *q* – – –(4*e*)	a^7 – *q* – – –(5*c*)	... ...	... ...	... ...

1*H*193	a^1 ♂ *100xq*58.58.55(6*e*)	a^2 ♀ *00* *p* – – –(alb.)	… … …	… … …	0*H*112a^2 ♂ – *q* – – –(5*c*)	*A*185a^3 ♀ *00* *p* – – –(*A*1 or 2) or *A*2×)
1*H*194	a^1 ♀ *00* *p* – – –(alb.)	a^2 ♂ *00* *p* – – –(alb.)	a^3 ♀ *00* *p* – – –(alb.)	a^4 ♂ *00* *p* – – –(alb.)	0*H*111a^1 ♂ – *q* – – –(5*d*)	*A*142a^4 ♀ *00* *p* – – –(*A*1 or 2)
	a^5 ♂ *00* *p* – – –(alb.)	a^6 ♂ *100xq*48.48.47(6*c* : *e*)	a^7 ♂ *100xq* 48.46.43(5*c*)	a^8 ♀ *95* *q*52.46.12(5*d*)	… … … …	… … … …
	a^9 ♂ – *q* – – –(3*e*)	… … …	… … …	… … …	… … … …	… … … …
1*H*195	a^1 ♀ *00* *p* – – –(alb.)	a^2 ♀ *00* *p* – – –(alb.)	a^3 ♂ *00* *p* – – –(alb.)	a^4 ♂ – *q* – – –(6*e*)	0*H*84a^9 ♂ *100xq*48.46.28(5*c*)	*A*142a^5 ♀ *00* *p* – – –(*A*1 or 2)
	a^5 ♀ *90* *q*49.46.12(5*c*)	a^8 ♀ *100xq* 49.46.12(5*c*)	a^7 ♀ *100xq* 52.46.43(5*c*)	a^8 ♂ *100xq* 52.47.12(5*d*)	… … … …	… … … …
1*H*196	a^1 ♂ *00* *p* – – –(alb.)	a^2 ♀ *00* *p* – – –(alb.)	a^3 ♀ *00* *p* – – –(alb.)	a^4 ♂ *00* *p* – – –(alb.)	0*H*90a^2 ♂ – *q* – – –(5*c*)	*A*142a^6 ♀ *00* *p* – – –(*A*1 or 2)
	a^5 ♂ *00* *p* – – –(alb.)	a^6 ♂ *100yq*55.53.12(6*d*)	a^7 ♂ *100xq*51.51.47(6*d*)	a^8 ♂ *100xq*49.46.47(6*d*)	… … … …	… … … …
	a^9 ♂ *100xq*48.46.47(6*d*)	… … …	… … …	… … …	… … … …	… … … …
1*H*197	a^1 ♀ *00* *p* – – –(alb.)	a^2 ♀ *00* *p* – – –(alb.)	a^3 ♀ *00* *p* – – –(alb.)	a^4 ♀ *00* *p* – – –(alb.)	0*H*85a^5 ♂ – *q* – – –(5*d*)	*A*150a^6 ♀ *00* *p* – – –(*A*1 or 2)
	a^5 ♀ *95* *q*49.51.14(5*c*)	a^6 ♀ *90* *q*48.51.14(5*c*)	… … …	… … …	… … … …	… … … …
1*H*198	a^1 ♀ *00* *p* – – –(alb.)	a^2 ♀ *00* *p* – – –(alb.)	a^3 ♀ – *q* – – –(6*e*)	a^4 ♂ – *q* – – –(6*e*)	0*H*100a^3 ♂ – *q* – – –(5*c*)	*A*153a^5 ♀ *00* *p* – – –(*A*1 or 2)
	a^5 ♀ – *q* – – –(6*e*)	a^6 ♀ *90* *q*52.46.11(5*c*–*d*)	a^7 ♀ *85* *q*49.46.11(5*c*–*d*)	a^8 ♂ – *q* – – –(4*e*)	… … … …	… … … …
	a^9 – *q* – – –(4*c*)	… … …	… … …	… … …	… … … …	… … … …
1*H*199	a^1 ♂ *100zq* 48.46.43(5*c*)	a^2 ♀ *00* *p* – – –(alb.)	a^3 ♀ *00* *p* – – –(alb.)	a^4 ♂ *00* *p* – – –(alb.)	0*H*102a^4 ♂ – *q* – – –(5*c*)	*A*153a^6 ♀ *00* *p* – – –(*A*1 or 2)
	a^5 ♂ *00* *p* – – –(alb.)	a^6 ♂ *00* *p* – – –(alb.)	a^7 ♂ – *q* – – –(4*e*)	… … …	… … … …	… … … …
1*H*200	a^1 ♂ *50* *q*40. 1. 1(3*b*–*c*)	a^2 ♀ *00* *p* – – –(alb.)	a^3 ♀ *00* *p* – – –(alb.)	a^5 ♂ *00* *p* – – –(alb.)	0*H*114a^6 ♂ – *q* – – –(5*c*)	*A*146a^3 ♀ *00* *p* – – –(*A*2×)
	a^5 ♀ *00* *p* – – –(alb.)	… … …	… … …	… … …	… … … …	… … … …
1*H*201	a^1 ♂ – *q* – – –(5*a*)	a^2 ♂ *00* *p* – – –(alb.)	a^3 ♂ *00* *p* – – –(alb.*w*)	a^4 ♀ – *q* – – –(5*a*)	0*H*84a^7 ♂ *100zq*35.33.28(5*a*)	0*H*12a^5 ♀ – *q* – – –(5*a*)
	a^5 ♀ – *q* – – –(5*a*)	a^6 ♀ *00* *p* – – –(alb.)	a^7 ♀ – *q* – – –(2–3*a*)	… … …	… … … …	… … … …
1*H*202	a^1 *85* *p*39.35. 3(4*a*)	a^2 ♂ – *p* – – –(5*a*)	a^3 ♂ *00* *p* – – –(alb.)	a^4 ♀ *00* *p* – – –(alb.)	0*H*111a^2 ♂ – *q* – – –(5*a*)	0*H*111a^7 ♀ – *q* – – –(5*a*)
1*H*203	a^1 ♀ *85* *q*53.51. 1(5*c*)	a^3 ♀ *85* *q*51.51. 2(5*c*)	a^3 ♂ *55* *q*33. 6. 6 (5*a*)	a^4 ♂ *100yq*33.30.30(5*a*)	*A*182a^1 ♂ *00* *p* – – –(*A*1 or 2)	0*H*12a^3 ♀ – *q* – – –(5*a*)
	a^5 ♀ *00* *p* – – –(alb.)	a^6 ♂ *00* *p* – – –(alb.)	… … …	… … …	… … … …	… … … …
1*H*204	a^1 ♂ *80* *q*52.51. 4(5*c*)	a^2 ♂ – *q* – – –(5*c*)	a^3 ♂ – *q* – – –(5*a*)	a^4 ♀ – *q* – – –(5*a*)	*A*182a^2 ♂ *00* *p* – – –(*A*1 or 2)	0*H*111a^9 ♀ *100zq*35.34.29(5*a*)
	a^5 ♀ *00* *p* – – –(alb.)	a^6 ♂ *00* *p* – – –(alb.)	a^7 ♂ *00* *p* – – –(alb.)	… … …	… … … …	… … … …
1*H*205	a^1 ♀ *100zq* 35.33.30(5*a*)	a^2 ♀ – *q* – – –(5*a*)	a^3 ♂ *90* *q*53.51. 9(5*c*)	a^4 ♂ *90* *q*51.51. 7(5*c*)	*A*183a^2 ♂ *00* *p* – – –(*A*1 or 2)	0*H*111a^8 ♀ *100zq*35.35.30(5*a*)
	a^5 ♂ *80* *q*53.51. 7(5*c*)	a^6 ♂ – *q* – – –(5*c*)	… … …	… … …	… … … …	… … … …
1*H*206	a^1 ♂ *00* *p* – – –(alb.)	a^2 ♂ *00* *p* – – –(alb.)	a^3 ♀ *00* *p* – – –(alb.)	a^4 ♀ – *q* – – –(6*e*)	0*H*113a^7 ♂ – *q* – – –(5*c*)	*A*160a^1 ♀ *00* *p* – – –(*A*2×)
	a^5 ♂ *80* *q*52.51. 7(5*c*)	a^6 ♀ *85* *q*53.51. 4(4*c*)	a^7 ♂ – *q* – – –(3–4*c*)	a^8 ♀ *60* *q*44.47. 4(3–4*c*)	… … … …	… … … …
	a^9 ♀ *85* *q*52.51. 4(5*c*)	… … …	… … …	… … …	… … … …	… … … …
1*H*207	a^1 ♀ *00* *p* – – –(alb.)	a^2 ♂ *00* *p* – – –(alb.)	a^3 ♂ *00* *p* – – –(alb.)	a^4 ♂ – *q* – – –(6*e*)	0*H*113a^8 ♂ – *q* – – –(5*c*)	*A*160a^2 ♀ *00* *p* – – –(*A*2×)
	a^5 ♂ – *q* – – –(6*e*)	a^6 ♀ – *q* – – –(6*e*)	a^7 ♂ *80* *q*44.47. 2(4*d*)	a^8 – *q* – – –(4*c*)	… … … …	… … … …
	a^9 – *q* – – –(5*c*)	… … …	… … …	… … …	… … … …	… … … …
1*H*208	a^1 ♂ *95* *q*53.51. 1(4*c*)	a^2 ♀ *100xq*41.41.50(6*g*)	a^3 ♂ *00* *p* – – –(alb.)	a^4 ♀ *00* *p* – – –(alb.)	*A*158a^1 ♂ *00* *p* – – –(*A*1)	0*H*62a^5 ♀ *100zq*49.48.12(5*c*)
	a^5 ♀ *00* *p* – – –(alb.)	a^6 ♂ *00* *p* – – –(alb.)	a^7 *00* *p* – – –(alb.)	… … …	… … … …	… … … …
1*H*209	a^1 ♂ *00* *p* – – –(alb.)	a^2 ♀ *100zq* 40.37. 2(5*b*–*c*)	… … …	… … …	*A*158a^2 ♂ *00* *p* – – –(*A*1)	0*H*84a^3 ♀ *100zq*35.33.30(5*a*)
1*H*210	a^1 ♀ *00* *p* – – –(alb.)	a^2 ♂ *00* *p* – – –(alb.)	a^3 ♀ *95* *p*37.35.34(4*b*)	… … …	0*H*102a^3 ♂ *95* *q*48.46. 7(4*c*)	0*H*84a^6 ♀ *100zq*39.33.30(5*a*)
1*H*211	a^1 ♀ *40* *q*60.60. 1(3*e*)	a^2 ♀ *35* *q*53. 1. 1(2*c*)	a^3 ♂ *100zq* 41.26. 8(5*c*)	a^4 ♂ *100xq*58.58.60(6*e*)	0*H*114a^5 ♂ *25* *q*49. 1. 2(2*c*)	*A*146a^4 ♀ *00* *p* – – –(*A*2×)
	a^5 ♀ *00* *p* – – –(alb.)	a^6 ♀ *00* *p* – – –(alb.)	a^7 ♀ *00* *p* – – –(alb.)	… … …	… … … …	… … … …
1*H*212	a^1 ♂ *60* *q*58.57. 1(3*e*)	a^2 ♂ – *q* – – –(6*e*)	a^3 ♀ – *q* – – –(6*e*)	a^4 ♂ *00* *p* – – –(alb.)	0*H*112a^1 ♂ *30* *q*49. 1. 1(2*c*)	*A*146a^5 ♀ *00* *p* – – –(*A*2×)
	a^5 ♂ *00* *p* – – –(alb.)	a^6 ♀ *00* *p* – – –(alb.)	a^7 ♂ *00* *p* – – –(alb.)	… … …	… … … …	… … … …
1*H*213	a^1 ♂ *00* *p* – – –(alb.)	a^2 ♀ *00* *p* – – –(alb.)	a^3 ♀ *85* *q*49.51. 1(4*c*)	a^4 ♀ *85* *q*51.51. 1(4*c*)	0*H*102a^2 ♂ *55* *q*48. 1. 2(3*c*)	*A*146a^6 ♀ *00* *p* – – –(*A*2×)
	a^5 ♂ *40* *r* 40. 1. 3(3*b*–*c*)	a^6 ♂ *50* *q*47.51. 3(3*c*)	a^7 ♂ *75* *q*51.51. 4(4*c*)	… … …	… … … …	… … … …
1*H*214	a^1 ♂ *00* *p* – – –(alb.)	a^2 ♂ *00* *p* – – –(alb.)	a^3 ♂ *00* *p* – – –(alb.)	a^4 ♂ *00* *p* – – –(alb.)	0*H*120a^2 ♂ – *q* – – –(3*c*)	*A*146a^7 ♀ *00* *p* – – –(*A*2×)
	a^5 ♀ – *q* – – –(6*e*)	a^6 ♀ *100zq* 52.46.43(5–6, *c*–*d*)	a^7 ♀ – *q* – – –(4*e*)	a^8 ♂ – *q* – – –(3–4*e*)	… … … …	… … … …
1*H*216	a^1 ♀ *55* *q*41.50. 5(3*g*)	a^2 ♀ – *q* – – –(4*e*)	… … …	… … …	0*H*104a^4 ♂ *40* *q*48.46. 2(3*c*)	*A*158a^4 ♀ *00* *p* – – –(*A*1)
1*H*217	a^1 ♂ *00* *p* – – –(alb.)	a^2 ♂ *00* *p* – – –(alb.)	a^3 ♀ *00* *p* – – –(alb.)	a^4 ♂ *55* *q*40.37. 3(3*b*–*c*)	*A*147a^1 ♂ *00* *p* – – –(*A*2×)	0*H*85a^1 ♀ – *q* – – –(4*d*)
	a^5 ♀ *75* *q*41.50. 2(4*g*)	a^6 ♀ *35* *q*47. 1. 1(3*c*)	… … …	… … …	… … … …	… … … …

MATING	OFFSPRING				PARENTS	
					Father	Mother
1*H*218	a^1 ♂ *00 p– – –*(alb.)	a^3 ♀ *00 p– – –*(alb.)	a^3 ♀ *00 p– – –*(alb.)	a^4 ♂ *40 q40.37. 3(3b–c)*	*A*147a^2 ♂ *00 p– – –*(*A*2 ×)	0*H*112a^5 ♀ *40 q49. 1. 1(2c)*
	a^5 ♂ *30 q51. 1. 2(3c)*	a^6 ♀ *60 q58.57. 1(3–4e)*	a^7 ♂ *50 q58. 1. 1(3–4e)*	... ...	... ...	... ...
1*H*219	a^1 ♀ *00 p– – –*(alb.)	a^2 ♂ *00 p– – –*(alb.	a^3 ♂ *00 p– – –*(alb.)	a^4 ♀ *100zq51.51. 4(5c)*	*A*152a^1 ♂ *00 p– – –*(*A*1 or 2)	0*H*111a^6 ♀ *– q– – –(5d)*
	a^5 ♀ *– q– – –(6e)*	a^6 ♀ *100xq58.58.55(6e)*	... ...	... ...	... ...	... ...
1*H*220	a^1 ♀ *85 q48.46.11(5c)*	a^2 ♂ *100zq49.46. 7(5c)*	a^3 *– q– – –(5c)*	a^4 *00 p– – –*(alb.)	*A*152a^2 ♂ *00 p– – –*(*A*1 or 2)	0*H*120a^3 ♀ *45 q49. 1. 1(2c)*
	a^5 *00 p– – –*(alb.)	... ...	... ...	... ...	... ...	... ...
1*H*221	a^1 ♀ *100xq58.58.52(6e)*	a^2 ♂ *100xq58.58.57(6e)*	a^3 ♂ *85 q47.51. 4(5c)*	a^4 ♂ *00 p– – –*(alb.)	*A*152a^3 ♂ *00 p– – –*(*A*1 or 2)	0*H*101a^6 ♀ *45 q49.46. 1(3c)*
1*H*222	a^1 ♀ *00 p– – –*(alb.)	a^2 ♂ *00 p– – –*(alb.)	a^3 ♂ *00 p– – –*(alb.)	a^4 ♀ *00 p– – –*(alb.)	*A*159a^1 ♂ *00 p– – –*(*A*1)	0*H*117a^4 ♀ *90 q49.36. 1(4c)*
	a^5 ♂ *100xq40.37.36(5b–c)*	a^6 ♀ *100xq41.21.19(5b–c)*	a^7 ♂ *80 q52.51. 3(3c)*	a^8 *– q– – –(3–4c)*	... ...	... ...
	a^9 *– q– – –(5c)*	... ...	... ...	... ...	... ...	... ...
1*H*223	a^1 ♀ *00 p– – –*(alb.)	a^2 ♂ *100zq48.46. 7(5c)*	a^3 ♀ *90 q41.23. 1(4g)*	... ...	*A*159a^2 ♂ *00 p– – –*(*A*1)	0*H*6a^1 ♀ *– q– – –(2c)*
1*H*224	a^1 ♂ *30 q36. 1. 1(2a)*	a^2 ♀ *20 q61. 1. 1(2e)*	a^3 *25 p?23. 1. 1(2–3f)*	a^4 *– p?– – –(3f)*	0*H*13a^4 ♂ *45 q52. 1. 1(3c)*	0*H*113a^2 ♀ *50 q49.46. 2(3c)*
	a^5 *– q– – –(1cw)*	a^6 *00 p– – –*(alb.)	... ...	... ...	... ...	... ...
1*H*225	a^1 ♂ *35 q49.48. 1(3c)*	a^2 ♂ *85 q57.55. 1(4e)*	a^3 ♂ *– p– – –(2a)*	a^4 ♂ *00 p– – –*(alb.)	0*H*101a^2 ♂ *50 q49.46. 4(3c)*	0*H*120a^6 ♀ *75 q49.46. 1(4c)*
	a^5 *– q– – –(3c)*	a^6 *00 p– – –*(alb.*w*)	a^7 *– p– – –(3f)*	... ...	... ...	... ...
1*H*226	a^1 ♂ *00 p– – –*(alb.)	a^2 ♂ *00 p– – –*(alb.)	a^3 ♀ *45 p39. 1. 1(3b)*	a^4 ♀ *55 q61.60. 1(4ew)*	0*H*120a^4 ♂ *60 q49.46. 1(3c)*	0*H*61a^6 ♀ *65 q49.30. 7(3c)*
	a^5 ♀ *00 p– – –*(alb.)	a^6 ♀ *55 p37.39. 1(3bw)*	... ...	... ...	... ...	... ...
1*H*227	a^1 ♂ *35 q48. 1. 1(2cw)*	a^2 ♂ *00 p– – –*(alb.)	a^3 ♀ *60 p22. 1. 1(4f)*	a^4 ♀ *60 q57.55. 1(3ew)*	0*H*45a^3 ♂ *– q– – –(2d)*	0*H*74a^5 ♀ *80 q49.46. 2(4c)*
	a^5 ♀ *65 p37.35. 1(3–4bw)*	a^6 ♀ *25 q58. 1. 1(2e)*	... ...	... ...	... ...	... ...
1*H*228	a^1 ♂ *45 q48. 1. 3(3c)*	a^2 ♀ *55 q52. 1. 1(3d)*	a^3 ♂ *– q– – –(2c)*	a^4 ♂ *00 p– – –*(alb.)	0*H*114a^4 ♂ *50 q46.30. 5(3c)*	0*H*117a^5 ♀ *65 q49.36. 4(3c)*
	a^5 ♂ *00 p– – –*(alb.)	a^6 ♂ *00 p– – –*(alb.*w*)	... ...	... ...	... ...	... ...
1*H*229	a^1 ♂ *20 p22. 1. 1(3fw)*	a^2 ♀ *60 q49. 1. 1(4c)*	a^3 ♀ *35 q48. 1. 5(3c)*	a^4 *25 q47. 1. 1(2c)*	0*H*100a^1 ♂ *40 q49. 1. 1(3c)*	0*H*112a^4 ♀ *35 q46. 1. 1(2c)*
	a^5 ♂ *50p?18. 1. 1(2f)*	a^6 *– p– – –(2fw)*	... ...	... ...	... ...	... ...
1*H*230	a^1 ♀ *85 p35.35. 3(4b)*	... ...	... ...	... ...	0*H*110a^1 ♂ *60 q48.46. 1(3c)*	0*H*82a^1 ♀ *55 q48.46.12(3c)*
1*H*231	a^1 ♂ *65r?40.36. 4(3b–c)*	a^2 ♂ *– q– – –(3c)*	a^3 ♂ *00 p– – –*(alb.)	a^4 ♀ *50 q40. 1. 1(3c)*	0*H*120a^7 ♂ *50 q48.46. 3(3c)*	0*H*103a^5 ♀ *55 q49.46. 4(3c)*
	a^5 ♀ *50 q49.46. 1(3c–d)*	a^6 ♀ *50 q58.56. 1(3e)*	a^7 ♀ *85 q57.55. 1(4–5e)*	a^8 *00 p– – –*(alb.)	... ...	... ...
1*H*232	a^1 ♂ *65 q49.33. 1(3c)*	a^2 ♂ *65 q58.57. 1(4e)*	a^3 ♀ *55 p39.39. 2(3b)*	a^4 ♀ *35 p37. 1. 1(2b)*	0*H*102a^1 ♂ *70 q48.46. 2(4c)*	0*H*59a^1 ♀ *50 q48. 1. 4(3d)*
	a^5 ♀ *00 p– – –*(alb.)	a^6 *– p– – –(1bw)*	... ...	... ...	... ...	... ...
1*H*233	a^1 ♂ *30 q46. 1. 3(1–2c)*	a^2 ♂ *35 q48. 1. 3(2c)*	a^3 ♂ *– q– – –(2c)*	a^4 ♂ *– q– – –(2c)*	0*H*75a^5 ♂ *15 q49. 1. 1(1c)*	0*H*100a^6 ♀ *55 q49.46. 9(3c)*
	a^5 ♂ *00 p– – –*(alb.)	a^6 *– q– – –(2c)*	a^7 *– q– – –(2c)*	a^8 *– q– – –(2ew)*	... ...	... ...
	a^9 *00 p– – –*(alb.)	... ...	... ...	... ...	... ...	... ...
1*H*234	a^1 ♂ *100zq 49.48.20(5cw)*	a^2 ♂ *100xp37.19. 9(5–6f)*	a^3 ♀ *100xp22.15.15(5–6f)*	a^4 ♀ *40 q49. 1. 1(3c)*	0*H*103a^2 ♂ *– q– – –(5c)*	0*H*27a^1 ♀ *40 q58. 1. 2(2e)*
	a^5 *– p– – –(2fw)*	... ...	... ...	... ...	... ...	... ...
1*H*235	a^1 *80 q53.51. 4(5c)*	a^2 *– q– – –(4dw)*	a^3 *– q– – –(3e)*	a^4 *– q– – –(2c)*	0*H*101a^4 ♂ *– q– – –(5c)*	0*H*100a^5 ♀ *25 q46. 1. 1(2c)*
	a^5 *00 p– – –*(alb.)	a^6 *00 p– – –*(alb.)	... ...	... ...	... ...	... ...
1*H*236	a^1 *– p– – –(4a)*	a^2 *– q– – –(4c)*	a^3 *– q– – –(3c)*	b^1 *– q– – –(3d)*	0*H*118a^1 ♂ *85 q48.46.11(4c)*	0*H*35a^2 ♀ *– q– – –(3d)*
	b^2 *– q– – –(3c)*	b^3 *– p– – –(3b)*	b^4 *00 p– – –*(alb.)	... ...	... ...	... ...
1*H*237	a^1 ♂ *60 p37. 3. 3(3bw)*	a^2 ♀ *30 p37. 1. 1(2aw)*	a^3 ♀ *95 p37.34. 3(5bw)*	a^4 ♂ *95 p23.36. 3(5bw)*	0*H*138a^3 ♂ *– q– – –(5c)*	0*H*128a^1 ♀ *85 q49.46. 1(4c)*
	a^5 ♀ *80 p37.33. 4(5b)*	a^6 ♀ *100zq53.51. 9(5c)*	a^7 ♀ *100zq* 48.36. 9(5c)	... ...	... ...	... ...
1*H*238	a^1 ♀ *00 p– – –*(alb.)	a^2 ♂ *00 p– – –*(alb.)	a^3 ♀ *100zq* 52.46.20(5d)	a^4 ♀ *– q– – –(5d)*	0*H*140a^5 ♂ *40 q49.46. 1(3c)*	0*H*133a^1 ♀ *100zq*49.46.12(5c)
	a^5 ♂ *35 p34. 1. 1(2b)*	a^6 ♂ *40 p37. 1. 4(3b)*	a^7 ♀ *15 p37. 1. 4(1bw)*	... ...	... ...	... ...
1*H*239	a^1 ♂ *90 p18.18. 3(4fw)*	a^2 ♀ *85 p37.36. 3(4bw)*	a^3 ♀ *90 p37.36. 3(5b)*	a^4 ♀ *35 q41. 1. 1(3g)*	0*H*152a^2 ♂ *– q– – –(5c)*	0*H*140a^6 ♀ *40 q46. 1. 1(3c)*
	a^6 ♀ *60 q49.46. 4(4c)*	a^6 *– q– – –(3c)*	a^7 *– p– – –(3b)*	... ...	... ...	... ...
1*H*240	a^1 ♂ *30 p35. 1. 1(3aw)*	a^2 ♂ *90 p35.33.28(4a)*	a^3 ♀ *35 p37. 3. 3(3b)*	a^4 ♂ *55 q35.35. 1(3a)*	0*H*129a^4 ♂ *35 q46.46. 3(2c)*	0*H*131a^3 ♀ *95 q35.35. 2(4a)*
	a^5 ♀ *85 q35.33. 3(4a)*	a^6 ♂ *65 q48.34. 3(3c)*	a^7 ♀ *00 p– – –*(alb.)	... ...	... ...	... ...

1*H*241	a^1 40 *p*37. 1. 1(3*b*) a^5 – *q* – – –(3*dw*)	a^2 – *p* – – –(2*aw*)	a^3 – *q* – – –(2*cw*)	a^4 – *q* – – –(3*c*)	0*H*129a^6♂ 35 *q*49.36. 1(2*c*)	0*H*131a^2♀ 60 *q*49.46. 3(3*d*)
1*H*242	a^1♂ 35 *q*48.46. 1(2–3*c*) a^5♂ – *q* – – –(3*c*)	a^2♀ 00 *p* – – –(alb.)	a^3♀ – *p* – – –(5*a*)	a^4♂ – *q* – – –(3*c*)	0*H*136a^1♂ 40 *q*47.28. 2(3*c*)	0*H*131a^4♀ 95 *q*35.35.29(6*a*)
1*H*243	a^1♂ 100*zq*35.35.28(5*aw*) a^5♀ 55 *p*37.29. 3(3*b*)	a^2♂ 90 *q*36.33. 1(5*a*)	a^3♂ 00 *p* – – –(alb.)	a^4♂ 60 *q*48.46. 3(3*c*)	0*H*131a^1♂ 100*zq*35.33.29(4–5*a*)	0*H*129a^1♀ – *q* – – –(3*c*)
1*H*244	a^1♂ 40 *q*51. 2. 2(3*cw*) a^5♂ 35 *q*46. 1. 1(2–3*c*)	a^2♂ 60 *q*49.46. 4(3*c*) a^6♀ 00 *p* – – –(alb.)	a^3♀ – *q* – – –(3*c*)	a^4♀ 35 *p*37.35. 1(2*a–b*)	0*H*129a^5♂ 35 *q*49. 1. 1(3*c*)	0*H*129a^3♀ 25 *q*49. 1. 1(2*c*)
1*H*245	a^1♀ – *q* – – –(3–4*c*) a^5♂ 70 *p*37.37.30(3*b*)	a^2♀ 65 *q*53. 1. 3(3*c*) a^6♀ 55 *p*37.19. 4(3*b*)	a^3♂ 20 *p*37. 1. 1(2*bw*)	a^4♂ 35 *p*37.37. 1(3*b*)	0*H*127a^5♂ 65 *q*49.46. 1(4*c*)	0*H*129a^2♀ 50 *q*49. 1. 1(3*c*)
1*H*246	a^1♀ 90 *q*47.51. 3(4*c*) a^5♂ 100*xp*37.37. 9(5*b*)	a^2♀ 100*xq*48.51.47(6*d*) a^6♂ 00 *p* – – –(alb.)	a^3♂ 100*xq*53.51.47(6*d*)	a^4♂ – *q* – – –(6*d*)	0*H*127a^3♂ 50 *q*52. 1. 2(3*c*)	0*H*143a^2♀ – *q* – – –(5*c*)
1*H*248	a^1♀ 00 *p* – – –(alb. *w*) a^5♀ – *q* – – –(5*c–d*)	a^2♂ 100*xq*53.51.47(6*dw*) a^6♂ 00 *p* – – –(alb.)	a^3♂ 100*zq*53.51. 9(5*cw*) a^7♀ – *q* – – –(4*c*)	a^4♂ 100*zp*37.37. 9(5*bw*)	0*H*135a^1♂ 50 *q*49.46. 1(3*c*)	0*H*143a^6♀ – *q* – – –(5*c*)
1*H*249	a^1♀ 90 *q*53.46.11(5*cw*) a^5♂ 100*xq*52.46.47(6*d*)	a^2♂ 00 *p* – – –(alb.*w*) a^6♀ – *q* – – –(4*c*)	a^3♂ 00 *p* – – –(alb.*w*) a^7♀ 70 *q*46.47. 2(3*c*)	a^4♀ 100*xq*53.51.47(6*d*)	0*H*143a^1♂ – *q* – – –(5*c*)	0*H*138a^1♀ – *q* – – –(5*c*)
1*H*250	a^1♂ 45 *q*44. 3. 3(3*c–d*) a^5♂ 00 *p* – – –(alb.)	a^2♂ – *q* – – –(5*c*)	a^3♂ 00 *p* – – –(alb.)	a^4♂ 00 *p* – – –(alb.)	0*H*143a^3♂ – *q* – – –(5*c*)	0*H*138a^4♀ 50 *q*49. 1. 1(3*c*)
1*H*252	a^1♂ – *q* – – –(4*e*)	a^2♂ 00 *p* – – –(alb.*w*)	... ...	... ...	0*H*124a^1♂ 100*zq*49.21.20(4*c*)	0*H*154a^2♀ 35 *q*49. 1. 1(2–3*c*)
1*H*253	a^1 90 *q*39.36. 1(4*a*)	a^2 100*xq*39.35.36(5*a*)	... ...	... ...	0*H*145a^2♂ 100*zq*35.35.30(5*a–b*)	0*H*145a^6♀ 100*zq*35.33.30(5–6*a–b*)
1*H*254	a^1♀ – *p* – – –(5*a–bw*)	a^2♀ 00 *p* – – –(alb.)	... ...	... ...	0*H*155a^1♂ 100*xq*35.35.30(5*a*)	0*H*145a^7♀ 100*zq*39.35.30(5*a–b*)
1*H*255	a^1♂ 100*zq*35.33.28(5*aw*) a^5 – *p* – – –(5*a*)	a^2♀ 00 *p* – – –(alb.*w*)	a^3♂ 00 *p* – – –(alb.)	a^4♀ 100*xq*30.30.28(5*a*)	0*H*146a^2♂ 100*zq*35.33. 4(5*a*)	0*H*145a^8♀ 100*zq*39.35.30(5–6*a–b*)
1*H*256	a^1♀ 100*zq*49.46.12(5*cw*) a^5 – *p* – – –(4*bw*)	a^3♂ 85 *p*37.37. 3(5*b*)	a^3♂ 100*zq*48.46.12(5*c*)	a^4♀ 70 *p*37.37. 2(4*b*)	0*H*145a^1♂ 100*zq*49.48. 9(5*c*)	0*H*146a^4♀ – *q* – – –(5*c*)
1*H*257	a^1♂ 00 *p* – – –(alb. *w*) a^6♂ 00 *p* – – –(alb.)	a^2♀ 00 *p* – – –(alb.*w*) a^6♂ 00 *p* – – –(alb.)	a^3♂ 00 *p* – – –(alb.)	a^4♂ 00 *p* – – –(alb.)	0*H*145a^5♂ 00 *p* – – –(alb.)	0*H*146a^5♀ 00 *p* – – –(alb.)
1*H*258	a^1♂ 00 *p* – – –(alb.)	a^3♂ 00 *p* – – –(alb.)	... ...	... ...	0*H*146a^3♂ 00 *p* – – –(alb.)	0*H*146a^6♀ 00 *p* – – –(alb.)
1*H*260	a^1♀ 00 *p* – – –(alb.)	b^1 – *q* – – –(5*c*)	b^2 00 *p* – – –(alb.)	b^3 00 *p* – – –(alb.)	*A*167a^1 ♂ 00 *p* – – –(*A* × 2)	0*H*117a^3♀ 95 *q*49.46. 4(4*c*)
1*H*261	a^1♀ 75 *q*48.48. 1(4*c*) a^5♂ 00 *p* – – –(alb.)	a^2♀ 80 *q*48.46. 4(5*c*) a^6♀ 00 *p* – – –(alb.)	a^3♀ 00 *p* – – –(alb.) a^7♂ 00 *p* – – –(alb.)	a^4♀ 00 *p* – – –(alb.)	*A*163a^1 ♂ 00 *p* – – –(*A* × 2)	0*H*117a^1♀ 80 *q*49.46. 1(4*c*)
1*H*262	a^1♂ 100*xp*19. 6. 6(5*b*) a^5 00 *p* – – –(alb.)	a^2♀ 45 *q*58. 1. 1(3*e*) a^6 – *q* – – –(5*c*)	a^3♀ 20 *p*37. 1. 1(2*bw*)	a^4♀ 40 *p*37. 1. 1(3*b*)	0*H*104a^3♂ 40 *q*46. 1. 1(3*c*)	0*H*111a^4♀ – *q* – – –(5*d*)
1*H*263	a^1♀ 35 *q*53. 4. 4(3*cw*) a^5♂ 40 *q*49. 1. 1(2–3*c*)	a^2♀ 00 *p* – – –(alb.*w*)	a^3♀ 100*zq*48.46.20(5*c*)	a^4♀ 00 *p* – – –(alb.)	0*H*139a^2♂ – *q* – – –(5*c*)	0*H*124a^2♀ 90 *q*49.34. 1(4*c*)
1*H*264	a^1 100*xq*53.51.47(6*c*) a^5 00 *p* – – –(alb.)	a^2 100*xq*52.51.47(6*c*) a^6 00 *p* – – –(alb.)	a^3 80 *q*52.51.11(5*c*) a^7 00 *p* – – –(alb.)	a^4 100*xq*61.61.54(6*e*)	*A*150a^3 ♂ 00 *p* – – –(*A*1 or 2)	0*H*85a^3 ♀ – *q* – – –(5*d*)
1*H*265	a^1 35 *q*48. 1. 1(2*c*) a^5 00 *p* – – –(alb.)	a^2 – *p* – – –(4*b*)	a^3 00 *p* – – –(alb.)	a^4 00 *p* – – –(alb.)	0*H*102a^2♂ 55 *q*48. 1. 2(3*c*)	0*H*112a^3♀ 50 *q*48.46. 1(3*c*)
1*H*266	a^1 85 *q*39.35. 3(5*a*) a^5 00 *p* – – –(alb.)	a^2 80 *p*30.28. 4(4*aw*) a^6 00 *p* – – –(alb.)	a^3 100*zq*39.39.30(5*a*)	a^4 100*zq* 35.33.28(5*a*)	0*H*84a^7 ♂ 100*zq*35.33.28(5*a*)	0*H*84a^4 ♀ 100*zq*35.33.30(5*a*)
1*H*267	a^1 00 *p* – – –(alb.) a^5 – *p* – – –(5*b*)	a^2 – *p* – – –(5*b*) a^6 – *q* – – –(4*c*)	a^3 – *p* – – –(5*b*) a^7 – *p* – – –(3*b*)	a^4 100*xq* 48.46.43(5*cw*)	0*H*103a^3♂ – *q* – – –(5*c*)	0*H*118a^2♀ – *q* – – –(5*c*)
1*H*268	a^1 100*zq* 49.46. 9(5*c*) a^5 00 *p* – – –(alb.)	a^2 – *q* – – –(3*c*) a^6 00 *p* – – –(alb.)	a^3 00 *p* – – –(alb.)	a^4 00 *p* – – –(alb.)	*A*150a^4 ♂ 00 *p* – – –(*A*1 or 2)	0*H*73a^5 ♀ – *q* – – –(3*c*)
1*H*269	a^1♀ 65 *p*33.28. 2(5*a*) a^5 00 *p* – – –(alb.)	a^2♀ 100*zp*33.30.30(5*a–b*) a^6 00 *p* – – –(alb.*w*)	a^5♀ 70 *p*35.33. 2(5*a–b*) a^7 00 *p* – – –(alb.)	a^4 100*zq* 48.46. 4(5*c*)	0*H*111a^2♂ – *q* – – –(5*a*)	0*H*84a^5 ♀ 100*zq*33.30.28(5*a*)
1*H*270	a^1♀ 100*xq*58.58.55(6*e*) a^5 00 *p* – – –(alb.)	a^2♀ 90 *q*58.55. 2(4–5*e*) a^6 00 *p* – – –(alb.)	a^3 – *q* – – –(6*e*) a^7 00 *p* – – –(alb.)	a^4 – *q* – – –(5*c*)	*A*81a^2 ♂ 00 *p* – – –(*A*2 ?)	0*H*85a^4 ♀ – *q* – – –(5-6*d*)

MATING	OFFSPRING				PARENTS	
					Father	Mother
1*H*271	a^1 *80 q58.58. 2(4e)*	a^2 *75 q48.34. 4(4c)*	a^3 – *q* – – –(5c)	a^4 *00 p* – – –(alb.)	*A153a*^{1} ♂ *00 p* – – –(*A*1or2)	0*H45a*^{4} ♀ *q* – – –(2*d*)
	a^5 *00 p* – – –(alb.)	a^6 *00 p* – – –(alb.)	a^7 *00 p* – – –(alb.)	... ...	... ...	... ...
1*H*272	a^1 *65 q49.46. 1(4c)*	a^2 *100zq49.46.20(5c)*	a^3 *85 q49.46. 1(4c)*	a^4 *100zq48.46. 9(5c)*	*A150a*^{5} ♂ *00 p* – – –(*A*1or2)	0*H94a* ♀ – *q* – – –(3*c*)
	a^5 – *q* – – –(4c)	a^6 *00 p* – – –(alb.)	a^7 *00 p* – – –(alb.)	... ...	... ...	... ...
1*H*273	a^1 *100zq49.34. 9(5c)*	a^2 ♂ *100zq58.58.55(6e)*	a^3 – *q* – – –(5c)	a^4 *00 p* – – –(alb.)	*A153a*^{2} ♂ *00 p* – – –(*A*1or2)	0*H114a*^{2} ♀ *35 q49.46. 1(3c)*
	a^5 *00 p* – – –(alb.)	a^6 *00 p* – – –(alb.)	... ...	... ...	... ...	... ...
1*H*274	a^1 ♀ *100zq57.57.55(6e)*	a^2 ♀ *100zq58.57.55(6e)*	a^3 ♀ *100zq48.46.14(5-6c:e)*	a^4 ♀ *100zq58.58.55(6e)*	0*H86a*^{1} ♂ *100zq49.46. 9(5c)*	*A182a*^{6} ♀ *00 p* – – –(*A*1 or2)
	a^5 *100zq57.57.55(6e)*	a^6 *00 p* – – –(alb.)	a^7 *00 p* – – –(alb.)	... ...	... ...	... ...
1*H*275	a^1 – *q* – – –(3*c*)	a^2 – *p* – – –(3*a*)	a^3 *00 p* – – –(alb.)	a^4 *00 p* – – –(alb.)	0*H139a*^{1} ♂ *20 q49. 1. 2(2c)*	0*H148a*^{3} ♀ *45 q49.36. 1(3c)*
	a^5 *00 p* – – –(alb.*w*)	... ...	... ...	... ...	... ...	... ...
1*H*276	a^1 ♀ *75* 48.46. 1	a^2 ♀ *55 p37.39. 4(4b)*	a^3 ♀ *100zp35.35.28(5b)*	... ...	0*H156a*^{1} ♂ *00 p* – – –(alb.)	0*H155a*^{2} ♀ *00 p* – – –(alb.)
1*H*277	a^1 *00 p* – – –(alb.)	a^2 *00 p* – – –(alb.)	a^3 *00 p* – – –(alb.)	a^4 *00 p* – – –(alb.)	0*H156a*^{2} ♂ *00 p* – – –(alb.)	0*H155a*^{3} ♀ *00 p* – – –(alb.)
	a^5 *00 p* – – –(alb.)	a^6 *00 p* – – –(alb.)	a^7 *00 p* – – –(alb.)	... ...	... ...	... ...
1*H*278	a^1 – *q* – – –(5c)	a^2 *00 p* – – –(alb.)	a^3 *00 p* – – –(alb.)	a^4 *00 p* – – –(alb.)	0*H145a*^{4} ♂ *100zq36.30.28(5a–b)*	0*H156a*^{3} ♀ *00 p* – – –(alb.)
	a^5 *00 p* – – –(alb.)	... ...	... ...	... ...	... ...	... ...
1*H*279	a^1 *00 p* – – –(alb.)	... ...	... ...	... ...	0*H146a*^{1} ♂ *90 q49.34. 2(4c)*	0*H156a*^{4} ♀ *100zq48.46.20(5b–c)*
1*H*280	a^1 *85 q49.48. 1(4c)*	a^2 *00 p* – – –(alb.)	a^3 *00 p* – – –(alb.)	... ...	0*H145a*^{3} ♂ *100zq35.35.30(5a–b)*	0*H146a*^{7} ♀ *00 p* – – –(alb.)
1*H*281	a^1 ♀ *100zp39.39. 6(5b)*	a^2 – *q* – – –(4*c*)	a^3 – *q* – – –(5*cw*)	a^4 – *p* – – –(5*b*)	0*H160a*^{2} ♂ – *q* – – –(5*c*)	0*H161a*^{4} ♀ – *q* – – –(5*c*)
1*H*283	a^1 ♀ *80 p39.35. 2(5b)*	... ...	... ...	... ...	0*H159a*^{3} ♂ – *q* – – –(5*c*)	0*H161a*^{6} ♀ – *q* – – –(5*c*)
1*H*286	a^1 – *q* – – –(5*c*)	a^2 – *q* – – –(3*c*)	a^3 – *p* – – –(5*b*)	a^4 *00 p* – – –(alb.*w*)	0*H161a*^{2} ♂ *80 q48.46. 7(5c)*	0*H170a*^{4} ♀ – *q* – – –(5*c*)
	a^5 *00 p* – – –(alb.)	... ...	... ...	... ...	... ...	... ...
1*H*287	a^1 *85 q40.37. 9(5b–c)*	a^2 *85 q51.51. 2(5c)*	a^3 *75 q61. 1. 1(3ew)*	a^4 *80 p37.37. 1(4b)*	0*H161a*^{3} ♂ – *q* – – –(5*c*)	0*H170a*^{5} ♀ *90 q49.35. 2(4c)*
1*H*288	a^1 *35 q47. 1. 1(2c)*	a^2 *30 q47. 1. 1(2c)*	a^3 *00 p* – – –(alb.)	... ...	0*H120a*^{7} ♂ *50 q48.46. 3(3c)*	0*H120a*^{2} ♀ *45 q49. 1. 1(2c)*
1*H*289	a^1 *100zq49.48.12(5cw)*	a^2 *95 q49.46.11(5cw)*	a^3 *100zp15.15.15(6f)*	a^4 *00 p* – – –(alb.)	0*H100a*^{3} ♂ – *q* – – –(5*c*)	0*H100a*^{8} ♀ – *q* – – –(5*c*)
	a^5 *00 p* – – –(alb.)	... ...	... ...	... ...	... ...	... ...
1*H*290	a^1 *100zq49.48.47(6c)*	a^2 *80 q49.46. 1(4c)*	a^3 *95 q49.34. 9(4c)*	a^4 *00 p* – – –(alb.)	0*H90a*^{2} ♂ – *q* – – –(5*c*)	0*H117a*^{4} ♀ *90 q49.36. 1(4c)*
	a^5 *00 p* – – –(alb.)	... ...	... ...	... ...	... ...	... ...
1*H*291	a^1 *100zp26.26.22(5fw)*	a^2 *30 p37. 1. 1(2b)*	a^3 *85 p37.35. 3(5b)*	a^4 – *q* – – –(3*c*)	0*H111a*^{1} ♂ – *q* – – –(5*d*)	0*H7a*^{6} ♀ *100zq48.46.12(5c)*
	a^5 *00 p* – – –(alb.)	a^6 *00 p* – – –(alb.)	a^7 *00 p* – – –(alb.)	... ...	... ...	... ...
1*H*292	a^1 *100yp23.23.15(5f)*	a^2 *100yp19.19. 9(5f)*	a^3 *85 p37.35. 4(5b)*	a^4 *90 q61.54. 1(4e)*	0*H102a*^{4} ♂ – *q* – – –(5*c*)	0*H62a*^{5} ♀ *100zq49.48.12(5c)*
	a^5 *100zq49.46.11(5c)*	a^6 – *q* – – –(5*c*)	... ...	... ...	... ...	... ...
1*H*293	a^1 *100zp39.35.30(5b)*	a^2 *60 q47.46. 1(3c)*	a^3 *00 p* – – –(alb.)	a^4 *00 p* – – –(alb.)	0*H100a*^{2} ♂ – *q* – – –(5*c*)	0*H111a*^{3} ♀ – *q* – – –(5*d*)
	a^5 *00 p* – – –(alb.)	... ...	... ...	... ...	... ...	... ...
1*H*295	a^1 *100zp36.34.28(5b-fw)*	a^2 *45 q50. 1. 1(2c)*	a^3 *100zp37.37. 4(5b)*	a^4 *25 p26. 1. 1(2f)*	0*H112a*^{2} ♂ – *q* – – –(5*c*)	0*H102a*^{6} ♀ – *q* – – –(5*c*)
1*H*296	a^1 *100zq48.46.11(5c)*	a^2 *50 p37. 1. 1(3b)*	a^3 *100zq46.46. 7(5c)*	a^4 *100zp36.36.30(5b)*	0*H103a*^{1} ♂ – *q* – – –(5*c*)	0*H111a*^{5} ♀ – *q* – – –(5*d*)
1*H*297	a^1 *100zq48.46.12(5c)*	a^2 *100zq55.46.12(5c)*	a^3 *100zq49. 9. 9(5c)*	a^4 *100zq49.25. 2(5c)*	0*H59a*^{2} ♂ *100zq49.46. 7(6d)*	0*H62a*^{4} ♀ *100zq49.46. 7(5c)*
	a^5 – *q* – – –(4*c*)	... ...	... ...	... ...	... ...	... ...
1*H*298	a^1 *50 q44. 1. 1(2c)*	a^2 *100xq58.58.55(5ew)*	a^3 *100xp24.24.15(5fw)*	a^4 – *q* – – –(5*c*)	0*H103a*^{3} ♂ – *q* – – –(5*c*)	0*H111a*^{6} ♀ – *q* – – –(5*d*)
	a^5 *00 p* – – –(alb.)	a^6 *00 p* – – –(alb.)	... ...	... ...	... ...	... ...
1*H*300	a^1 *85 q49.46. 2(4c)*	a^2 *65 q61.61. 1(3ew)*	a^3 *40 p37. 1. 1(3b)*	a^4 *80 p37.35. 4(4b)*	0*H120a*^{4} ♂ *60 q49.46. 1(3c)*	0*H85a*^{1} ♀ – *q* – – –(4*d*)
	a^5 *80 p23.34. 4(4b)*	a^6 *00 p* – – –(alb.)	... ...	... ...	... ...	... ...
1*H*301	a^1 *50 q49.46. 1(2c)*	a^2 *30 q49. 1. 1(2c)*	a^3 – *p* – – –(2*b–c*)	a^4 – *q* – – –(2*ew*)	0*H114a*^{5} ♂ *25 q49. 1. 2(2c)*	0*H112a*^{5} ♀ *40 q49. 1. 1(2c)*
	a^5 *30 q49. 1. 1(2c)*	... ...	... ...	... ...	... ...	... ...
1*H*302	a^1 *100zq58.58.55(6e)*	a^2 *100zq55.46.14(6d)*	a^3 *90 p36.36. 9(5b)*	a^4 *35 p40. 1. 1(2b)*	0*H86a*^{2} ♂ *100zq49.46.28(5c)*	0*H102a*^{5} ♀ – *q* – – –(5*c*)
	a^5 *55 q55. 1. 1(3c)*	a^6 *100zq55.46.12(6c)*	a^7 *00 p* – – –(alb.)	a^8 *00 p* – – –(alb.)	... ...	... ...

1*H*304	a^1 65 *q*49.34. 1(3*c*)	a^2 30 *p*37. 1. 1(2*b*)	a^3 35 *p*37. 1. 1(2*b*)	a^4 35 *q*44. 1. 1(2*c*)	0*H*140a^5♂ 40 *q*49.46. 1(3*c*)	0*H*140a^6♀ 40 *q*46. 1. 1(3*c*)
	a^5 00 *p* – – –(alb.)	... ...	... ...	... ...	... ...	... ...
1*H*305	a^1 80 *q*48.46. 7(5*c*)	a^2 100*zp*35.33.30(5*aw*)	a^3 45 *q*35. 1. 3(2*a*)	a^4 00 *p* – – –(alb.)	0*H*138a^3♂ – *q* – – –(5*c*)	0*H*131a^4♀ 95 *q*35.35.29(6*a*)
1*H*306	a^1 100*xq*58.58.57(6*ew*)	a^2 100*zq*49.46.47(5*c*)	a^3 80 *q*49.46.12(3*c*)	a^4 80 *p*39.35. 3(4*b*)	0*H*152a^2♂ – *q* – – –(5*c*)	0*H*154a^2♀ 35 *q*49. 1. 1(2–3*c*)
	a^5 – *q* – – –(3*c*)	a^6 00 *p* – – –(alb.)	... ...	... ...	... ...	... ...
1*H*308	a^1 – *q* – – –(2*c*)	a^2 20 *p*37. 1. 1(2*b*)	a^3 50 *p*37. 1. 1(3*bw*)	a^4 40 *p*37. 9. 9(2*bw*)	0*H*127a^3♂ 50 *q*52. 1. 2(3*c*)	0*H*129a^1♀ – *q* – – –(3*c*)
	a^5 50 *q*55.46. 1(2*c*)	a^6 00 *p* – – –(alb.*w*)	... ...	... ...	... ...	... ...
1*H*309	a^1 100*xq*49.48.47(6*cw*)	a^2 00 *p* – – –(alb.)	a^3 00 *p* – – –(alb.*w*)	a^4 00 *p* – – –(alb.)	0*H*143a^1♂ – *q* – – –(5*c*)	0*H*138a^4♀ 50 *q*49. 1. 1(3*c*)
	a^5 00 *p* – – –(alb.)	a^6 00 *p* – – –(alb.)	... ...	... ...	... ...	... ...
1*H*310	a^1 100*zq*55.46.12(5*d*)	a^2 100*zq*48.46.14(5*c*)	a^3 100*zp*37.36. 3(5*b*)	a^4 85 *q*48.46. 7(5*c*)	0*H*143a^3♂ – *q* – – –(5*c*)	0*H*138a^1♀ – *q* – – –(5*c*)
	a^5 00 *p* – – –(alb.)	a^6 00 *p* – – –(alb.)	... ...	... ...	... ...	... ...
1*H*311	a^1 70 *p*37.34. 1(4*bw*)	a^2 100*zp*37.35. 9(5*b*)	a^3 80 *p*23.35. 4(4*b*)	a^4 100*xq*46.47.47(6*d*)	0*H*135a^1♂ 50 *q*49.46. 1(3*c*)	0*H*143a^6♀ – *q* – – –(5*c*)
	a^5 90 *q*49.46. 4(4*c*)	a^6 95 *q*49.46. 1(4*c*)	a^7 – *p* – – –(2*b*)	... ...	... ...	... ...
1*H*312	a^1 50 *q*46. 1. 1(3*e*)	a^2 30 *q*46. 1. 1(2*c*)	a^3 30 *q*47. 1. 1(2*c*)	a^4 55 *q*48.46. 1(3*c*)	0*H*129a^4♂ 35 *q*46.46. 3(2*c*)	0*H*129a^3♀ 25 *q*49. 1. 1(2*c*)
	a^5 – *p* – – –(2*b*)	a^6 – *q* – – –(4*c*)	a^7 00 *p* – – –(alb.*w*)	a^8 00 *p* – – –(alb.)	... ...	... ...
1*H*313	a^1 45 *q*58. 1. 1(2*ew*)	a^2 100*x* 58.58.55(6*e*)	a^3 55 *p*37. 1. 3(3*b*)	a^4 100*zq*49.48. 7(5*cw*)	0*H*139a^2♂ – *q* – – –(5*c*)	0*H*128a^1♀ 85 *q*49.46. 1(4*c*)
	a^5 00 *p* – – –(alb.*w*)	... ...	... ...	... ...	... ...	... ...
1*H*314	a^1 80 *q*49.46. 1(3*c*)	a^2 80 *q*48.46.11(4*c*)	a^3 50 *q*49.46. 3(2*c*)	a^4 80 *q*48.46.11(6*c*)	0*H*143a^5♂ – *q* – – –(5*c*)	0*H*129a^2♀ 50 *q*49. 1. 1(3*c*)
	a^5 80 *p*37.35. 3(5*b*)	... ...	... ...	... ...	... ...	... ...
1*H*318	a^1 100*zp*37.35. 1(5*b*)	a^2 55 *q*47.47. 1(3*c*)	a^3 100*zq*46.46. 9(5*c*)	a^4 00 *p* – – –(alb.)	0*H*85a^5♂ – *q* – – –(5*d*)	0*H*6a^1 ♀ – *q* – – –(2*c*)
1*H*319	a^1 100*zq*33.33.28(5*a*)	a^2 100*zq*35.34.28(5*a*)	a^3 – *q* – – –(5*a*)	a^4 – *q* – – –(5*a*)	0*H*84a^7♂ 100*zq*35.33.28(5*a*)	0*H*111a^9♀ 100*zq*35.34.29(5*a*)
	a^5 00 *p* – – –(alb.)	... ...	... ...	... ...	... ...	... ...
1*H*320	a^1 50 *q*61.60. 1(2*e*)	a^2 95 *p*36.35. 4(4*b*)	a^3 75 *q*46.46. 1(4*c*)	a^4 45 *q*49.46. 1(3*c*)	0*H*13a^4♂ 45 *q*52. 1. 1(3*c*)	0*H*103a^4♀ 55 *q*49. 1. 3(3*c*)
	a^5 80 *q*58.55. 1(4*e*)	a^6 00 *p* – – –(alb.)	a^7 00 *p* – – –(alb.)	... ...	... ...	... ...
1*H*321	a^1 90 *r*37.37. 2(4*b–c*)	a^2 80 *p*37.37. 1(2*b*)	a^3 80 *q*52.47. 4(4*c*)	a^4 50 *q*58. 1. 1(2*e*)	0*H*101a^2♂ 50 *q*49.46. 4(3*c*)	0*H*113a^2♀ 50 *q*49.46. 2(3*c*)
	a^5 00 *p* – – –(alb.)	a^6 00 *p* – – –(alb.)	... ...	... ...	... ...	... ...
1*H*322	a^1 20 *q*47. 1. 1(1*c*)	a^2 – *p* – – –(3*bw*)	a^3 00 *p* – – –(alb.*w*)	a^4 00 *p* – – –(alb.*w*)	0*H*101a^4♂ – *q* – – –(5*c*)	0*H*61a^6 ♀ 65 *q*49.30. 7(3*c*)
	a^5 00 *p* – – –(alb.)	a^6 00 *p* – – –(alb.)	... ...	... ...	... ...	... ...
1*H*323	a^1 100*xq*58.58.57(5*ew*)	a^2 15 *p*37. 1. 1(1*b*)	a^3 85 *p*37.37. 3(5*b*)	a^4 60 *q*46.46. 1(3*c*)	0*H*101a^3♂ – *q* – – –(5*c*)	0*H*82a^1 ♀ 55 *q*48.46.12(3*c*)
	a^5 00 *p* – – –(alb.)	a^6 00 *p* – – –(alb.*w*)	... ...	... ...	... ...	... ...
1*H*324	a^1 45 58. 1. 1(2*e*)	a^2 no details	... ...	... ...	0*H*45a^3♂ – *q* – – –(2*d*)	0*H*59a^1 ♀ 50 *q*48. 1. 4(3*d*)
1*H*325	a^1 30 *p*37. 1. 1(2*bw*)	a^2 40 *q*48. 1. 1(3*c*)	a^3 – *q* – – –(2*cw*)	... ...	0*H*110a^1♂ 60 *q*48.46. 1(3*c*)	0*H*120a^6♀ 75 *q*49.46. 1(4*c*)
1*H*326	a^1 80 *p*37.35. 3(5*b*)	a^2 90 *q*48.21.11(5*c*)	a^3 90 *r*40. 1. 1(3-4*b-c*)	a^4 – *q* – – –(5*c*)	0*H*102a^1♂ 70 *q*48.46. 2(4*c*)	0*H*111a^4♀ – *q* – – –(5*d*)
	a^5 – *p* – – –(5*fw*)	a^6 00 *p* – – –(alb.)	a^7 00 *p* – – –(alb.)	... ...	... ...	... ...
1*H*328	a^1 60 *p*35. 1. 2(3*a*)	a^2 45 *p*35. 2. 2(2*a*)	a^3 – *q* – – –(4*a*)	a^4 – *q* – – –(5*cw*)	0*H*111a^2♂ – *q* – – –(5*a*)	0*H*110a^2♀ 60 *y*52.46. 2(3*c*)
	a^5 00 *p* – – –(alb.)	a^6 00 *p* – – –(alb.)	... ...	... ...	... ...	... ...
1*H*329	a^1 100*zq* 48.46.20(5*c*)	a^2 80 *q*48.46. 4(5*c*)	a^3 45 *q*44. 1. 3(2*c*)	a^4 100*yp*35.34.28(5*b*)	0*H*86a^1 ♂100*zq*49.46. 9(5*c*)	0*H*111a^8♀ 100*zq*35.35.30(5*a*)
	a^5 100*zp*37.37. 4(5*b*)	a^6 – *q* – – –(5*c*)	a^7 – *q* – – –(2*a*)	a^8 00 *p* – – –(alb.)	... ...	... ...
1*H*331	a^1 85 *p*48.48. 4(5*c*)	a^2 30 *q*49. 1. 1(2*cw*)	a^3 80 *q*49.48. 1(3*c*)	a^4 100*zp*37.34. 3(5*b*)	0*H*104a^3♂ 40 *q*46. 1. 1(3*c*)	0*H*114a^1♀ – *q* – – –(5*c*)
	a^5 00 *p* – – –(alb.)	a^6 00 *p* – – –(alb.)	... ...	... ...	... ...	... ...
1*H*333	a^1 100*xq*58.58.57(6*e*)	a^2 100*xq*58.58.57(6*e*)	a^3 100*zq*48.48.14(5*c*)	a^4 – *q* – – –(5*c*)	*A*152a^3 ♂ 00 *p* – – –(*A*1 or 2)	0*H*100a^6♀ 55 *q*49.46. 9(3*c*)
	a^5 00 *p* – – –(alb.)	a^6 00 *p* – – –(alb.)	... ...	... ...	... ...	... ...
1*H*334	a^1 – *q* – – –(5*c*)	a^2 00 *p* – – –(alb.)	a^3 00 *p* – – –(alb.)	a^4 00 *p* – – –(alb.)	*A*153a^1 ♂ 00 *p* – – –(*A*1 or 2)	0*H*74a^5 ♀ 80 *q*49.46. 2(4*c*)
	a^5 00 *p* – – –(alb.)	... ...	... ...	... ...	... ...	... ...
1*H*335	a^1 95 *q*49.46.12(4*c*)	a^2 00 *p* – – –(alb.)	a^3 00 *p* – – –(alb.)	a^4 00 *p* – – –(alb.)	*A*159a^2 ♂ 00 *p* – – –(*A*1)	0*H*117a^5♀ 65 *q*49.36. 4(3*c*)
	a^5 00 *p* – – –(alb.)	a^6 00 *p* – – –(alb.)	... ...	... ...	... ...	... ...
1*H*336	a^1 100*zq*48.46. 7(5*c*)	a^2 75 *q*48.46. 1(3*c*)	a^3 100*zq*46.46.14(5*c*)	a^4 90 *q*48.46.14(4*c*)	*A*133a^6 ♂ 00 *p* – – –(*A* × 2)	0*H*103a^5♀ 55 *q*49.46. 4(3*c*)
	a^5 00 *p* – – –(alb.)	a^6 00 *p* – – –(alb.)	a^7 00 *p* – – –(alb.)	a^8 00 *p* – – –(alb.)	... ...	... ...
1*H*337	a^1 55 *p*26.26. 1(3*f*)	a^2 35 *p*39. 1. 1(2*bw*)	a^3 40 *r*40. 1. 1(2*c*)	a^4 00 *p* – – –(alb.*w*)	0*H*102a^2♂ 55 *q*48. 1. 2(3*c*)	0*H*27a^1 ♀ 40 *q*58. 1. 2(2*e*)
1*H*341	a^1 100*xq*49.48.47(6*c*)	a^2 100*zq*49.46.20(5*c*)	a^3 100*xq*49.46.47(6*c*)	a^4 100*zq*48.36. 9(5*c*)	0*H*102a^3♂ 95 *q*48.46. 7(4*c*)	*A*30a^1 ♀ 00 *p* – – –(*A*2 ?)
	a^5 100*zq*49.36.11(5*c*)	a^6 00 *p* – – –(alb.)	a^7 00 *p* – – –(alb.)	... ...	... ...	... ...

MATING	OFFSPRING				PARENTS	
					Father	Mother
2*H*11	a^1 ♂ *45* p40.39. 1(2*b*)	a^2 ♀ – *p* – – –(2–3*b*)	… … …	… … …	1*H*70a^2 ♂ *55* *q*37.33.30(3*a*)	1*H*19b^1 ♀ *40* *q*58. 1. 1(2*e*)
2*H*12	a^1 ♀ *90* *p*37.30. 4(5*a*–*b*)	a^2 ♀ *100zp*37.30. 3(5*a*–*b*)	a^3 ♀ *100zp*39.39.34(5*b*–*c*)	a^4 ♀ – *p* – – –(4*a*–*b*)	1*H*42a^2 ♂ *90* *p*39.35. 4(4*a*)	1*H*129a^4 ♀ *100zp*39.35.30(5*b*)
	a^5 ♂ *40* p39. 1. 1(2*b*)	… … …	… … …	… … …	… … …	… … …
2*H*13	a^1 ♂ *100zp*26.23.18(6*f*)	a^2 ♂ *100zp*26.23.19(6*f*)	a^3 ♂ *100zp*22.23.17(6*f*)	a^4 ♂ *100zp*23.23.18(6*f*)	1*H*122a^4 ♂ *55* *p*23. 1. 1(3*f*)	1*H*129a^3 ♀ *100zp*24.23.15(6*f*)
2*H*15	a^1 ♀ *80* *p*36. 1. 3(4*b*)	a^2 ♂ – *p* – – –(3*b*)	a^3 ♂ – *p* – – –(3*b*)	a^4 ♀ *40* *p*39.35. 1(3*b*)	1*H*111a^5 ♂ *95* *p*35. 1. 3(4*bw*)	1*H*136a^4 ♀ *35* *p*39. 1. 1(2*b*)
	a^5 ♂ *00* *p* – – –(alb.)	… … …	… … …	… … …	… … …	… … …
2*H*18	a^1 – *p* – – –(6*b*–*c*)	a^2 – *q* – – –(6*d*)	a^3 – *q* – – –(6*d*)	a^4 – *p* – – –(6*f*)	1*H*154a^2 ♂ – *q* – – –(6*e*)	1*H*152a^1 ♀ *100zq* 49.48.47(6*c*)
	a^5 *00* *p* – – –(alb.)	a^6 *00* *p* – – –(alb.)	… … …	… … …	… … …	… … …
2*H*19	a^1 ♂ *00* *p* – – –(alb.)	a^2 – *q* – – –(5*c*)	a^3 – *q* – – –(5*c*)	a^4 – *q* – – –(3*d*)	1*H*161a^2 ♂ *100zq* 48.46. 7(5*c*)	1*H*154a^1 ♀ *100zq*58.58.55(6*e*)
	a^5 – *q* – – –(3*c*)	… … …	… … …	… … …	… … …	… … …
2*H*20	a^1 ♂ *00* *p* – – –(alb.)	a^2 ♀ *00* *p* – – –(alb.)	a^3 ♂ *100zq*39.35.28(5*a*)	a^4 ♂ – *q* – – –(5*d*)	1*H*161a^6 ♂ – – – – –	1*H*151a^4 ♀ *80* *q*49.48.34(5*c*)
	a^5 ♀ – *q* – – –(6*d*)	a^6 ♀ – *q* – – –(4*a*)	a^7 – *q* – – –(5*a*)	… … …	… … …	… … …
2*H*22	a^1 ♂ *100yq*51.47. 2(4*c*)	a^2 ♀ *100zq* 49.46.43(5*c*)	a^3 ♀ – *q* – – –(5*c*)	a^4 ♂ *00* *p* – – –(alb.)	1*H*16a^2 ♂ *55* *q*58.55. 1(3*e*)	1*H*151a^1 ♀ *100zq* 49.48.34(5*c*)
	a^5 ♀ – *q* – – –(4*c*)	… … …	… … …	… … …	… … …	… … …
2*H*23	a^1 ♂ *100zp*39.39.30(5*b*)	a^2 ♂ *100zq* 49.48.47(5–6*c*)	a^3 ♀ *100zq* 48.48.20(5*c*)	a^4 ♂ *00* *p* – – –(alb.)	1*H*148a^2 ♂ *80* *q*49.46. 4(5*c*)	1*H*161a^3 ♀ *100zq* 49.48. 9(5*c*)
	a^5 ♂ *00* *p* – – –(alb.)	… … …	… … …	… … …	… … …	… … …
2*H*25	a^1 ♀ *00* *p* – – –(alb.)	a^2 ♀ *00* *p* – – –(alb.)	a^3 ♂ *00* *p* – – –(alb.)	a^4 ♀ – *q* – – –(6*e*)	1*H*60a^1 ♂ *100zq*57.57.55(6*e*)	1*H*158a^3 ♀ *100zq* 49.48.34(5*c*)
2*H*26	a^1 ♀ – *q* – – –(3*c*)	a^2 ♀ *00* *p* – – –(alb.)	a^3 *100zq* 48.46. 4(4*c*)	a^4 *00* *p* – – –(alb.)	1*H*60a^3 ♂ *75* *q*46.46. 4(4*c*)	1*H*157a^1 ♀ – *q* – – –(5*a*)
	a^5 – *q* – – –(5*a*)	a^6 – *q* – – –(4*a*)	… … …	… … …	… … …	… … …
2*H*27	a^1 ♂ – *q* – – –(6*ew*)	a^2 ♀ *75* *p*35.33.28(5*aw*)	a^3 ♀ *100zq* 35.33.28(5*a*)	a^4 ♀ *100zq* 35.33.28(5*a*)	1*H*80a^7 ♂ *100zq*57.57.55(6*e*)	1*H*157a^2 ♀ – *q* – – –(5*a*)
	a^5 ♂ – *q* – – –(3*e*)	… … …	… … …	… … …	… … …	… … …
2*H*28	a^1 ♂ *100zq* 55.46. 7(5*c*)	a^2 ♀ *100zp*26.26. 9(5*b*)	a^3 ♂ – *q* – – –(6*e*)	a^4 ♀ – *q* – – –(6*e*)	1*H*98a^1 ♂ – *q* – – –(4*e*)	1*H*157a^3 ♀ *100zq* 49.48.14(5*d*)
	a^5 ♂ – *q* – – –(5*c*)	… … …	… … …	… … …	… … …	… … …
2*H*29	a^1 ♀ *00* *p* – – –(alb.)	a^2 ♂ *100zq* 48.46.12(5*c*)	a^3 ♀ *100zq* 48.46.43(5*c*)	a^4 ♀ – *q* – – –(6*e*)	1*H*98a^3 ♂ *100zq* 49.46. 4(6*c*)	1*H*156a^1 ♀ *100zq*58.57.55(6*e*)
2*H*32	a^1 ♀ *100zq* 49.46.12(5*c*)	a^2 ♂ *90* *q*46.51.11(5*c*)	a^3 ♂ – *q* – – –(5*c*)	a^4 ♂ – *q* – – –(5*c*)	1*H*96a^1 ♂ *100zq* 48.46. 4(5*c*)	1*H*3a^3 ♀ *100zq* 49.46. 7(6*c*)
	a^6 ♀ – *q* – – –(4*c*)	… … …	… … …	… … …	… … …	… … …
2*H*33	a^1 ♀ *100zq*39.35.30(5*a*–*b*)	a^2 ♂ *100zq* 39.35.30(5*a*–*b*)	a^3 ♀ *100zq* 40.37.17(5*b*–*c*)	a^4 ♂ – *q* – – –(5*b*-*cw*)	1*H*96a^2 ♂ *100zq* 35.33.28(5–6*b*)	1*H*3a^4 ♀ *100zq* 46.36.20(5*c*)
	a^5 ♂ – *p* – – –(4*bw*)	a^6 ♂ *100zq* 49.25. 7(5*c*)	… … …	… … …	… … …	… … …
2*H*34	a^1 ♂ *60* *q*44.21. 2(3*c*)	a^2 ♀ – *q* – – –(3*c* : *e*)	a^3 – *q* – – –(6*e*)	a^4 ♂ *00* *p* – – –(alb.)	1*H*135a^2 ♂ *30* *q*60. 1. 1(2*e*)	1*H*3a^2 ♀ – *q* – – –(6*d*)
	a^5 – *q* – – –(4*c*)	a^6 – *q* – – –(6*e*)	a^7 – *p* – – –(3*b*)	… … …	… … …	… … …
2*H*36	a^1 ♀ *100zq* 49.46.12(5*c*)	a^2 ♂ *100zq*35.33.30(5*a*)	a^3 ♀ *55* *q*39.33. 4(3*a*)	… … …	1*H*101a^3 ♂ *65* *q*61.60. 3(3*e*)	1*H*97a^1 ♀ *100zq* 33.30.28(5–6*b*?)
2*H*37	a^1 ♂ – *q* – – –(4*e*)	a^2 ♀ – *q* – – –(3–4*e*)	a^3 ♀ – *q* – – –(6*e*)	a^4 ♀ *00* *p* – – –(alb.)	1*H*144a^1 ♂ – *q* – – –(2*e*)	1*H*88b^6 ♀ – *q* – – –(6*e*)
	a^5 ♀ *00* *p* – – –(alh.)	a^6 ♂ *00* *p* – – –(alb.)	… … …	… … …	… … …	… … …
2*H*38	a^1 ♂ *60* *q*48. 1. 4(3*b*–*c*)	a^2 ♀ *55* *p*40.39. 1(3*bw*)	a^3 ♀ *100zq* 49.48. 7(5*d*)	a^4 ♀ – *p* – – –(5*b*)	1*H*114a^5 ♂ *35* *q*48. 1. 1(2*c*)	1*H*65b^1 ♀ – *q* – – –(6*e*)
	a^5 ♀ – *p* – – –(5*b*)	a^6 ♂ *00* *p* – – –(alb.)	… … …	… … …	… … …	… … …
2*H*39	a^1 ♀ *95* *p*37.34. 1(5*b*)	a^2 ♀ *100zp*37.37. 9(5*b*)	a^3 ♂ *80* *q*49.48. 7(5*c*)	a^4 ♂ – *q* – – –(1*c*)	1*H*114a^2 ♂ *10* *q*58. 1. 1(1*e*)	1*H*98a^4 ♀ *100zq* 49.46.30(5*c*)
	a^5 ♀ – *q* – – –(2*c*)	a^6 ♂ – *q* – – –(2*c*)	a^7 ♀ – *q* – – –(2*c*)	b^1 – *p* – – –(5*b*)	… … … …	… … … …
	b^2 – *q* – – –(2*c*)	b^3 – *q* – – –(3*c*)	b^4 – *q* – – –(4*c*)	b^5 – *q* – – –(5*c*)	… … … …	… … … …
2*H*40	a^1 ♂ *100zq* 49.46. 9(5*b*–*c*)	a^2 ♂ *100zq* 46.36.28(5*c*)	a^3 ♀ – *q* – – –(5*b*–*c*)	… … …	1*H*131a^1 ♂ *45* *q*49.46. 1(3*c*)	1*H*98a^5 ♀ *100zq* 48.46. 4(5–6*c*)
2*H*41	a^1 ♂ *00* *p* – – –(alb.)	a^2 ♂ – *q* – – –(6*e*)	a^3 ♀ – *q* – – –(6*e*)	a^4 ♀ – *q* – – –(6*e*)	1*H*111a^3 ♂ *100zq* 48.46. 7(5*c*)	1*H*65b^2 ♀ *100zq*58.58.56(6*e*)
	a^5 ♀ *45* *q*47.47. 1(3*c*)	… … …	… … …	… … …	… … …	… … …
2*H*43	a^1 ♂ – *q* – – –(4*e*)	a^2 ♂ *65* *p*26.23. 1(4*f*)	a^3 ♀ – *q* – – –(3*e*)	a^4 ♂ – *q* – – –(3*e*)	1*H*113a^2 ♂ *65* *q*58. 1. 1(3*e*)	1*H*87a^1 ♀ *100zq*58.58.57(6*e*)
	a^5 – *p* – – –(3*f*)	a^6 – *q* – – –(6*e*)	a^7 – *q* – – –(6*e*)	a^8 – *p* – – –(3*f*)	… … … …	… … … …
2*H*44	a^1 ♂ *100zq* 48.46.12(5*c*)	a^2 ♂ *75* *q*49.46. 2(5*b*–*c*)	a^3 ♀ *00* *p* – – –(alb.)	a^4 ♂ *55* *q*49.36.11(3*c*)	1*H*100a^2 ♂ *30* *q*46. 1. 1(2*c*)	1*H*32a^5 ♀ *100zq* 49.46. 4(5–6*c*)
	a^5 ♀ *65* *q*46.46. 4(3–4*c*)	a^6 ♀ – *q* – – –(3*c*)	a^7 ♀ *40* *p*37.33. 1(3*a*)	b^1 *100zq*48.35.30(5*b*–*c*)	… … … …	… … … …

	b^2 *100zq* 49.46.12(5c)	b^3 *30 q*48. 1. 1(2c)	b^4 *00 p* – – –(alb.)	b^5 *00 p* – – –(alb.)		
2*H*45	a^1 ♂ *100zq* 49.46.11(4c)	a^2 ♀ – *q* – – –(5c)	a^3 ♂ – *q* – – –(5c)	a^4 ♀ *00 p* – – –(alb.)	1*H*143a^1 ♂ *100zq* 48.46. 2(5c)	1*H*80a^6 ♀ *100zq* 37.36. 4(5*g*)
	a^5 ♂ *00 p* – – –(alb.)	a^6 ♀ *00 p* – – –(alb.)	... ...	... ...	... ...	... ...
2*H*46	a^1 – *p* – – –(6*b*)	... ...	... ...	... ...	... ...	... ...
2*H*48	a^1 ♂ *100xq* 35.33.28(5*a*)	a^2 ♀ – *q* – – –(5*a*)	a^3 ♂ *00 p* – – –(alb.)	a^4 ♀ *00 p* – – –(alb.)	1*H*117a^1 ♂ *60 q*49.46. 1(5c)	1*H*121a^3 ♀ – *q* – – –(4*d*)
	a^5 ♂ – *p* – – –(4*a*)	... ...	... ...	... ...	1*H*115a^1 ♂ *30 q*47.46. 1(1*e*)	1*H*136a^3 ♀ – *q* – – –(5*a*)
2*H*49	a^1 ♂ – *q* – – –(6*e*)	a^2 ♂ *100xq* 58.57.55(6*e*)	a^3 ♀ *100xq* 58.57.55(6*e*)	a^4 ♂ *100zq* 49.46.11(5*c–d*)	1*H*119a^3 ♂ *55 q*49. 1. 1(3*e*)	1*H*142a^1 ♀ *100xq* 58.57.55(6*e*)
	a^5 ♂ – *q* – – –(6*e*)	a^6 ♀ *100zq* 49.48.14(5*c–d*)	... ...	... ...	... ...	... ...
2*H*50	a^1 ♀ *30 q*46. 1. 1(3*c*)	a^2 ♂ – *q* – – –(3–4*e*)	a^3 ♀ *40 q*46.46. 1(3*c*)	a^4 ♂ *55 q*46. 1. 1(2*c*)	1*H*121a^5 ♂ *55 q*48.46. 2(3*c*)	1*H*115a^3 ♀ *85 q*58.55. 1(4*e*)
	a^5 ♀ *00 p* – – –(alb.)	b^1 – *q* – – –(2*c*)	b^2 – *q* – – –(3*e*)	b^3 – *q* – – –(4*e*)	... ...	... ...
	b^4 – *q* – – –(4*e*)	b^5 *00 p* – – –(alb.)	... ...	... ...	... ...	... ...
2*H*51	a^1 ♀ – *q* – – –(3*g*)	a^2 ♀ – *q* – – –(3*c*)	a^3 ♀ – *q* – – –(3*c*)	a^4 ♂ – *q* – – –(3*e*)	1*H*122a^5 ♂ *25 q*46. 1. 1(2*c*)	1*H*113a^5 ♀ *95 q*49.48.12(4*c*)
	a^5 – *q* – – –(1*c*)	... ...	... ...	... ...	... ...	... ...
2*H*52	a^1 ♂ *100zp* 36.36. 2(5*b*)	a^2 *75 q*48.46.11(5c)	a^3 *60 q*46.46. 7(3*c*)	a^4 *100zq* 49.46.12(5c)	1*H*99a^3 ♂ *80 q*48.46. 7(5*d*)	1*H*100a^4 ♀ *65 q*49.46. 1(3*c–d*)
	a^5 ♀ *00 p* – – –(alb.)	... ...	... ...	... ...	... ...	... ...
2*H*53	a^1 ♂ – *q* – – –(3*e*)	a^2 ♂ – *q* – – –(3*e*)	a^3 ♂ – *q* – – –(6*e*)	a^4 ♂ – *q* – – –(3–4*e*)	1*H*118a^2 ♂ *55 q*49. 1. 2(3*c*)	1*H*101a^5 ♀ – *q* – – –(6*e*)
	a^5 ♀ – *q* – – –(4–5*e*)	a^6 ♂ – *q* – – –(5*c–d*)	a^7 ♀ – *q* – – –(6*e*)	a^8 *00 p* – – –(alb.*w*)	... ...	... ...
	b^1 – *q* – – –(3*c*)	b^2 – *p* – – –(3*b*)	b^3 – *q* – – –(3*c*)	b^4 – *q* – – –(6*e*)	... ...	... ...
	b^5 – *q* – – –(5*cw*)	... ...	... ...	... ...	... ...	... ...
2*H*55	a^1 ♀ *25 p*39. 1. 4(1-2*a-b*)	a^2 ♀ *35 p*39.39. 3(2*a–b*)	a^3 ♂ *10 p*37. 1. 1(1*a–b*)	a^4 – *p* – – –(5*a*)	1*H*99a^1 ♂ *100zp* 39.35.28(6*b*)	1*H*118a^1 ♀ – *p* – – –(2*b*)
2*H*59	a^1 ♂ *00 p* – – –(alb.)	a^2 ♀ *00 p* – – –(alb.)	a^3 ♂ *00 p* – – –(alb.)	a^4 ♀ *00 p* – – –(alb.)	1*H*157a^5 ♂ *00 p* – – –(alb.)	1*H*152a^3 ♀ *00 p* – – –(alb.)
	a^5 ♀ *00 p* – – –(alb.)	... ...	... ...	... ...	... ...	... ...
2*H*60	a^1 ♂ *00 p* – – –(alb.)	a^2 ♂ *00 p* – – –(alb.)	a^3 ♀ *00 p* – – –(alb.)	a^4 ♀ *00 p* – – –(alb.)	1*H*153a^2 ♂ *00 p* – – –(alb.)	1*H*152a^5 ♀ *00 p* – – –(alb.)
	a^5 ♀ *00 p* – – –(alb.)	... ...	... ...	... ...	... ...	... ...
2*H*61	a^1 ♀ *00 p* – – –(alb.)	... ...	... ...	... ...	... ...	1*H*16a^6 ♀ *00 p* – – –(alb.)
2*H*62	a^1 ♀ *00 p* – – –(alb.)	a^2 ♂ *00 p* – – –(alb.)	a^3 ♂ *00 p* – – –(alb.)	a^4 ♂ *60 p* – – –(alb.)	1*H*153a^4 ♂ *00 p* – – –(alb.)	1*H*16a^7 ♀ *00 p* – – –(alb.)
	a^5 ♀ *00 p* – – –(alb.)	... ...	... ...	... ...	1*H*143a^4 ♂ *00 p* – – –(alb.)	... ...
2*H*63	a^1 ♂ *00 p* – – –(alb.)	a^3 ♂ *00 p* – – –(alb.)	a^3 ♂ *00 p* – – –(alb.)	a^4 ♀ *00 p* – – –(alb.)	1*H*112a^4 ♂ *00 p* – – –(alb.)	1*H*85b^3 ♀ *00 p* – – –(alb.)
	a^5 ♂ *00 p* – – –(alb.)	a^6 ♂ *00 p* – – –(alb.)	b^1 *00 p* – – –(alb.)	b^3 *00 p* – – –(alb.)	... ...	... ...
	b^3 *00 p* – – –(alb.)	b^4 *00 p* – – –(alb.)	b^5 *00 p* – – –(alb.)	... ...	... ...	... ...
2*H*64	a^1 ♀ *00 p* – – –(alb.*w*)	a^2 ♂ *00 p* – – –(alb.)	a^3 ♀ *00 p* – – –(alb.)	a^4 ♀ *00 p* – – –(alb.)	1*H*115a^5 ♂ *00 p* – – –(alb.)	1*H*96a^3 ♀ *00 p* – – –(alb.)
	a^5 ♀ *00 p* – – –(alb.)	a^6 ♂ *00 p* – – –(alb.)	... ...	... ...	... ...	... ...
2*H*65	a^1 ♂ *00 p* – – –(alb.)	a^2 ♂ *00 p* – – –(alb.)	a^3 ♂ *00 p* – – –(alb.)	a^4 ♀ *00 p* – – –(alb.)	1*H*88b^1 ♂ *00 p* – – –(alb.)	1*H*96a^4 ♀ *00 p* – – –(alb.)
	a^5 ♂ *00 p* – – –(alb.)	... ...	... ...	... ...	... ...	... ...
2*H*66	a^1 ♂ *00 p* – – –(alb.)	a^2 ♂ *00 p* – – –(alb.)	a^3 ♀ *00 p* – – –(alb.)	a^4 ♀ *00 p* – – –(alb.)	1*H*119a^5 ♂ *00 p* – – –(alb.)	1*H*146a^5 ♀ *00 p* – – –(alb.)
2*H*67	a^1 ♂ *00 p* – – –(alb.)	a^2 ♀ *00 p* – – –(alb.)	a^3 ♂ *00 p* – – –(alb.)	a^4 ♂ *00 p* – – –(alb.)	1*H*123a^2 ♂ *00 p* – – –(alb.)	1*H*88b^2 ♀ *00 p* – – –(alb.)
	a^5 ♀ *00 p* – – –(alb.)	a^6 ♀ *00 p* – – –(alb.)	... ...	... ...	... ...	... ...
2*H*69	a^1 *00 p* – – –(alb.)	a^2 *00 p* – – –(alb.)	a^3 *00 p* – – –(alb.)	a^4 *00 p* – – –(alb.)	1*H*149a^5 ♂ *00 p* – – –(alb.)	1*H*88b^4 ♀ *00 p* – – –(alb.)
	a^5 *00 p* – – –(alb.)	a^6 *00 p* – – –(alb.)	... ...	... ...	... ...	... ...
2*H*70	b^1 *00 p* – – –(alb.)	b^2 *00 p* – – –(alb.)	... ...	... ...	1*H*16a^3 ♂ *00 p* – – –(alb.)	1*H*123a^3 ♀ *00 p* – – –(alb.)
2*H*71	a^1 ♂ *00 p* – – –(alb.)	a^2 ♂ *00 p* – – –(alb.)	a^3 ♂ *00 p* – – –(alb.)	a^4 ♀ *00 p* – – –(alb.)	1*H*16a^4 ♂ *00 p* – – –(alb.)	1*H*149a^4 ♀ *00 p* – – –(alb.)
	a^5 ♂ *00 p* – – –(alb.)	... ...	... ...	... ...	... ...	... ...
2*H*73	a^1 *00 p* – – –(alb.)	a^2 *00 p* – – –(alb.)	a^3 *00 p* – – –(alb.)	... ...	1*H*39a^4 ♂ *00 p* – – –(alb.)	1*H*142a^3 ♀ *00 p* – – –(alb.)
2*H*75	a^1 ♀ *00 p* – – –(alb.)	a^2 ♂ *00 p* – – –(alb.)	a^3 ♂ *00 p* – – –(alb.)	a^4 ♂ *00 p* – – –(alb.)	1*H*85b^5 ♂ *00 p* – – –(alb.)	1*H*140a^4 ♀ *00 p* – – –(alb.)
	a^5 ♂ *00 p* – – –(alb.)	... ...	... ...	... ...	... ...	... ...
2*H*76	a^1 *00 p* – – –(alb.)	a^2 *00 p* – – –(alb.)	a^3 *00 p* – – –(alb.)	a^4 *00 p* – – –(alb.)	1*H*92a^4 ♂ *00 p* – – –(alb.)	1*H*147a^4 ♀ *00 p* – – –(alb.)
	a^6 *00 p* – – –(alb.*w*)	a^6 *00 p* – – –(alb.)	... ...	... ...	... ...	... ...
2*H*77	a^1 ♂ *00 p* – – –(alb.)	a^2 ♂ *00 p* – – –(alb.)	a^3 ♀ *00 p* – – –(alb.)	a^4 ♀ *00 p* – – –(alb.)	1*H*92a^5 ♂ *00 p* – – –(alb.)	1*H*143a^5 ♀ *00 p* – – –(alb.)
	a^5 ♂ *00 p* – – –(alb.)	a^6 ♂ *00 p* – – –(alb.)	b^1 *00 p* – – –(alb.)	b^2 *00 p* – – –(alb.)	... ...	... ...
	b^3 *00 p* – – –(alb.)	b^4 *00 p* – – –(alb.)	... ...	... ...	... ...	... ...

MATING	OFFSPRING				PARENTS	
					Father	Mother
2*H*79	a^1 ♀ *85 q49.51. 4(3c)*	a^3 ♀ – *q* – – –(4*c*)	a^3 ♀ – *q* – – –(4*c*)	a^4 ♂ – *q* – – –(4*c*)	1*H*70a^2 ♂ *55 q37.33.30(3a)*	*A*159a^3 ♀ *00 p* – – –(*A*1)
	a^5 ♀ – *q* – – –(3*e*)	a^6 ♂ – *q* – – –(3*e*)	a^7 ♀ – *q* – – –(3*c*)	a^8 ♂ – *q* – – –(6*e*)	… … …	… … … …
	a^9 ♀ – *q* – – –(6*e*)	… … …	… … …	… … …	… … …	… … … …
2*H*80	a^1 ♀ *100xq*58.57.56(6*e*)	a^2 ♀ *60 q58. 1. 1(3–4e)*	… … …	… … …	1*H*122a^4 ♂ *55 p23. 1. 1(3f)*	*A*159a^4 ♀ *00 p* – – –(*A*1)
2*H*82	a^1 ♀ *95 q41.41. 1(4g)*	a^2 ♀ *85 q41.50. 3(4g)*	a^3 ♀ – *q* – – –(4*g*)	a^4 ♂ *00 p* – – –(alb.)	1*H*16a^1 ♂ *95 q41.50. 4(4g)*	*A*158a^5 ♀ *00 p* – – –(*A*1)
	a^5 ♂ *00 p* – – –(alb.)	a^6 ♂ *00 p* – – –(alb.)	… … …	… … …	… … …	… … … …
2*H*83	a^1 ♀ – *q* – – –(4*e*)	a^2 ♂ – *q* – – –(4*e*)	a^3 ♀ – *q* – – –(6*e*)	a^4 ♀ – *q* – – –(6*e*)	1*H*60a^1 ♂ *100xq*57.57.55(6*e*)	*A*91a^2 ♀ *00 p* – – –(*A*1½)
	a^5 ♂ *00 p* – – –(alb.)	a^6 ♂ *00 p* – – –(alb.)	a^7 ♀ *00 p* – – –(alb.)	a^8 ♂ *00 p* – – –(alb.)	… … …	… … … …
	a^9 *00 p* – – –(alb.)	… … …	… … …	… … …	… … …	… … … …
2*H*85	a^1 ♀ – *p* – – –(3*b*)	a^2 ♀ – *p* – – –(3*b*)	a^3 ♂ *80 p37. 1. 1(2–3b)*	a^4 ♂ *45 p37. 1. 1(2–3b)*	1*H*74b^1 ♂ *35 p23. 1. 1(2a)*	1*H*117b^2 ♀ – *p* – – –(3*f*)
	a^5 ♂ *30 p36. 1. 2(2–3b)*	a^6 ♂ – *p* – – –(3*b*)	… … …	… … …	… … …	… … … …
2*H*87	a^1 *95 q46.46. 4(4b–c)*	a^2 *00 p* – – –(alb.)	a^3 *00 p* – – –(alb.)	a^4 *00 p* – – –(alb.)	*A*153a^4 ♂ *00 p* – – –(*A*1½)	1*H*103b^1 ♀ *60r?* 40.39. 1(4*b*–*c*)
2*H*88	a^1 *95 q40.37. 9(4b–c)*	a^2 *90 q48.39.30(4b–c)*	a^3 *85 q37.36. 3(4b–c)*	a^4 *00 p* – – –(alb.)	*A*158a^2 ♂ *00 p* – – –(*A*1)	1*H*103b^3 ♀ *55 porr* 40.35. 1(4*b*)
2*H*90	a^1 – *q* – – –(5*b*)	a^2 – *q* – – –(5*c*)	a^3 – *q* – – –(5*c*)	a^4 – *q* – – –(5*c*)	*A*147a^1 ♂ *00 p* – – –(*A*2 ×)	1*H*96b^3 ♀ *100xp* 35.33.28(5*a*–*b*)
	a^5 – *q* – – –(5*c*)	a^6 – *q* – – –(5*c*)	… … …	… … …	… … …	… … … …
2*H*92	a^1 *60 q48.46. 1(3c)*	a^2 – *q* – – –(3*c*)	a^3 – *q* – – –(4*c*)	… … …	1*H*150a^2 ♂ *100xq* 48.46. 7(4*c*)	1*H*115b^1 ♀ *45 q* 58.57. 2(3*e*)
2*H*93	a^1 – *p* – – –(2*f*)	a^2 – *q* – – –(3*c*)	a^3 – *q* – – –(3*e*)	a^4 – *p* – – –(4*f*)	1*H*100b^3 ♂ *60 q55.46. 1(4c)*	1*H*115b^2 ♀ – *q* – – –(4*e*)
	a^5 *00 p* – – –(alb.)	b^1 ♂ *100zp*35.35.28(5*b*)	b^2 *100z* 48.46.30(5*d**)	b^3 *85* 49.39. 1(4*b*–*c**)	… … …	… … … …
	b^4 *35* 49. 1. 1(2*d**)	b^5 *35* 49. 1. 1(2*d**)	… … …	… … …	… … …	… … … …
2*H*96	a^1 ♂ *100xq*58.57.55(6*e*)	a^2 ♀ *50 q58.58. 2(3e)*	a^3 *100xq* 49.51.30(5*c*)	a^4 *100xq* 52.51.29(5*d*)	1*H*115b^3 ♂ *65 q49.46. 3(4c)*	1*H*142b^3 ♀ *100xq* 58.57.55(6*e*)
	a^5 – *q* – – –(5*d*)	a^6 – *q* – – –(3*g*)	a^7 ♀ *00 p* – – –(alb.)	… … …	… … …	… … … …
2*H*99	a^1 *65 q40.40. 1(4b–c)*	a^2 *80 q37.36. 4(4b–c)*	a^3 – *q* – – –(5*c*)	a^4 *00 p* – – –(alb.)	1*H*142b^1 ♂ *80 q48.46. 2(5c)*	1*H*103a^3 ♀ – *q* – – –(4*b*–*c*)
	a^5 *00 p* – – –(alb.)	… … …	… … …	… … …	… … …	… … … …
2*H*100	a^1 *00 p* – – –(alb.)	a^2 *00 p* – – –(alb.)	a^3 *00 p* – – –(alb.)	… … …	1*H*123b^4 ♂ *80 q46.46. 4(5c–d)*	1*H*168a^6 ♀ *100zq* 33.33.28(5*a*)
2*H*101	a^1 *100xq*33.30.28(5*a*)	a^2 *100xq*48.46.47(6*c*)	a^3 *100xq*49.46.47(6*c*)	a^4 – *q* – – –(6*c*)	1*H*123b^5 ♂ *100xq*57.56.55(6*e*)	1*H*168a^7 ♀ *100zq* 35.30.28(5*a*)
	a^5 – *q* – – –(6*c*)	a^6 *00 p* – – –(alb.)	a^7 *00 p* – – –(alb.)	… … …	… … …	… … … …
2*H*102	a^1 ♂ *100xq*58.57.55(6*e*)	a^2 *100xq*33.30.28(5*a*)	a^3 – *q* – – –(6*e*)	a^4 – *q* – – –(5*a*)	1*H*123b^6 ♂ *100zp* 35.33.28(5–6*b*)	1*H*168a^4 ♀ *00 p* – – –(alb.)
	a^5 – *q* – – –(5*a*)	a^6 – *q* – – –(5*c*)	a^7 – *q* – – –(5*c*)	… … …	… … …	… … … …
2*H*103	a^1 ♀ – *q* – – –(4–5*e*)	a^2 ♂ *70 q58.55. 1(4e)*	a^3 *70 q49.46. 4(5c)*	a^4 *40 q49. 1. 3(3c)*	1*H*123b^1 ♂ *60 q58.55. 1(3e)*	1*H*158b^5 ♀ *100xq* 49.48.14(5*c*)
	a^5 *80 q48.46.11(5c)*	… … …	… … …	… … …	… … …	… … … …
2*H*104	a^1 *100xq* 48.46. 9(5*c*)	a^2 *100xq* 46.36. 7(5*c*)	… … …	… … …	1*H*130b^1 ♂ *30 p37. 1. 1(2a–b)*	1*H*169a^1 ♀ *00 p* – – –(alb.)
2*H*105	a^1 *70 q48.34. 3(4c)*	a^2 – *q* – – –(3*c*)	a^3 – *q* – – –(3*c*)	a^4 – *q* – – –(3*c*)	1*H*130b^3 ♂ *35 p39.35. 1(2a–b)*	1*H*169a^3 ♀ *00 p* – – –(alb.)
2*H*106	a^1 *45 q58. 1. 1(2e)*	a^2 *90 q48.46. 2(4d)*	a^3 *00 p* – – –(alb.)	a^4 *00 p* – – –(alb.)	1*H*124b^3 ♂ *65 q58.54. 2(4e)*	1*H*169a^4 ♀ *100zq* 49.48.47(5*c*–*d*)
2*H*107	a^1 *70 q49.48. 1(3c)*	a^2 *100zq* 49.48. 7(5*d*)	a^3 *45 p50.37. 1(3f)*	a^4 *55 p48.36. 1(3f)*	1*H*112b^2 ♂ *35 q48. 1. 3(2c)*	1*H*169a^6 ♀ *100zq* 48.46. 4(6*c*)
	a^5 *80 q50. 1. 1(3c)*	a^6 *100zp*26.35.30(5*b*)	… … …	… … …	… … …	… … … …
2*H*108	a^1 ♀ *100xq*58.57.56(6*e*)	a^2 ♂ *100xq*58.56.56(6*ew*)	a^3 ♀ *55 q58.55. 3(3–4e)*	a^4 *100xq* 48.46. 9(5*c*)	1*H*139a^2 ♂ – *p* – – –(1–2*f*)	1*H*171a^2 ♀ *00 p* – – –(alb.)
	a^5 – *q* – – –(3*cw*)	a^6 – *q* – – –(4*e*)	a^7 – *q* – – –(5*c*)	a^8 – *q* – – –(6*e*)	… … …	… … … …
2*H*109	a^1 *90 q58.58.55(4e)*	a^2 *90 q48.46.12(4c)*	a^3 *75 q48.46. 1(4c)*	a^4 *60 q48. 1. 1(4c)*	1*H*105a^4 ♂ *40 p37. 1. 1(2b)*	1*H*171a^5 ♀ *00 p* – – –(alb.)
	a^5 *60 q46.46. 1(4c)*	a^6 – *q* – – –(4*c*)	… … …	… … …	… … …	… … … …
2*H*110	a^1 – *q* – – –(6*d*)	a^2 – *q* – – –(6*d*)	a^3 – *q* – – –(6*dw*)	… … …	1*H*149b^3 ♂ *100zq* 49.46.20(5*d*)	1*H*167a^2 ♀ *100xq* 58.58.55(6*e*)
2*H*111	a^1 ♀ *60 q58. 1. 3(4e)*	a^2 *90 q35.33. 3(4a)*	a^3 *100yp*35.35.28(5*b*)	a^4 – *q* – – –(4*a*)	1*H*158b^3 ♂ *100zq* 33.33. 4(5*a*)	1*H*167a^3 ♀ *100zq* 49.46.21(6*c*)
2*H*112	a^1 *100xq*39.35.33(5*a*)	a^2 *80 q58. 1. 2(4e)*	a^3 *85 q58.55. 2(4e)*	a^4 *95 q35.35.33(5a)*	1*H*158b^4 ♂ *100zq* 35.30.28(5*a*)	1*H*143b^1 ♀ *95 q* 46.33. 1(4*c*)
	a^5 *95 q49.35. 2(4d)*	a^6 *100xq*58.58.55(6*e*)	a^7 – *q* – – –(4*a*)	a^8 – *q* – – –(4*e*)	… … …	… … … …
2*H*113	a^1 *100zq* 48.46. 9(5*c*)	a^2 – *q* – – –(3*c*)	a^3 *00 p* – – –(alb.)	a^4 *00 p* – – –(alb.)	1*H*158b^1 ♂ *100zq* 46.46. 9(5*c*)	1*H*151b^1 ♀ *100zq* 49.48.47(6*c*)

	a^6 00 p– – –(alb.)	... ...	... ...	... ...	... ...	... ...	... ...
2H114	a^1 ♂ 100q 58.58.55(6e)	a^2 85 q 48.34. 1(4d)	a^3 60 q 49.46. 1(4d)	a^4 – q – – –(6d)	1H167a^4 ♂ 100q 48.46.47(6c)	1H146b^1 ♀ 100q	52.46.20(5c–d)
2H115	a^1 ♀ – q – – –(4e)	a^2 – q – – –(4e)	a^3 – q – – –(5d)	a^4 00 p – – –(alb.)	1H167a^5 ♂ 100q 48.46.12(6d)	1H146b^2 ♀ 100q	49.46.20(5c)
2H116	a^1 ♂ 100p 39.35.28(5b)	a^2 ♀ 100p 35.35.30(5–6b)	a^3 ♂ – p – – –(5b)	a^4 – p – – –(5b)	1H165a^1 ♂ 80 q 49.46.11(5c)	1H149b^8 ♀ 100q	49.48.12(5d)
	a^5 00 p – – –(alb.)	a^6 00 p – – –(alb.)	... ...	... ...	... ...	... ...	... ...
2H117	a^1 ♂ – q – – –(6e)	a^2 ♀ 80 p 39.39. 2(5b)	a^3 ♂ 90 p 23.15. 2(4–5f)	a^4 55 q 48.46. 1(4c)	1H164a^1 ♂ 100q 58.58.55(6e)	1H122b^2 ♀ 70 q	49.46. 4(4c)
	a^5 65 q 49.46. 1(4c)	a^6 00 p – – –(alb.)	... ...	... ...	... ...	... ...	... ...
2H118	a^1 85 q 46.51. 4(5c)	a^2 100zq 43.46.43(5c)	a^3 100zq 48.46.12(5c)	a^4 55 q 37. 1. 3(3b)	1H164a^2 ♂ 100zq 36.36. 9(5c)	1H122b^1 ♀ 25 q	49. 1. 1(1c)
	a^5 100zq 37.37.30(5b)	... ...	... ...	... ...	... ...	... ...	... ...
2H119	a^1 ♀ 100xq 58.58.55(6e)	a^2 ♀ 100xq 58.58.55(6e)	a^3 65 q 58. 1. 1(4e)	a^4 – q – – –(5d)	1H169a^3 ♂ 100xq 58.58.55(6e)	1H119a^2 ♀ 100zq	52.46.43(5c)
	a^5 00 p – – –(alb.)	a^6 00 p – – –(alb.)	... ...	... ...	... ...	... ...	... ...
2H120	a^1 – q – – –(5c)	a^2 – q – – –(5c)	a^3 – p – – –(5b)	... ...	1H128b^1 ♂ 100zp 35.35. 4(5–6b)	1H146b^3 ♀ 00 p	– – –(alb.)
2H123	a^1 ♀ 100xq 58.58.56(6e)	a^2 100zq 48.46.34(5c)	a^3 100zq 49.46. 7(5c)	a^4 – q – – –(2e)	1H102b^1 ♂ 25 p 37. 1. 1(1–2b)	1H167a^7 ♀ 00 p	– – –(alb.)
	a^5 – q – – –(4c)	a^6 – q – – –(4e)	... ...	... ...	... ...	... ...	... ...
2H124	a^1 ♀ 100zq 58.57.56(6e)	a^2 ♂ 85 q 58.55. 2(4e*)	a^3 80 q 46.46. 3(4cw)	a^4 100z 44.47.14(5ch*)	1H153a^8 ♂ 00 p – – –(alb.)	1H121b^2 ♀ 75 p	39.34. 1(4a–b)
	a^5 00 p – – –(alb.)	a^6 00 p – – –(alb.)	... ...	... ...	... ...	... ...	... ...
2H125	a^1 100xq 48.46.47(5c)	a^2 – q – – –(2c)	a^3 – q – – –(3b–c)	a^4 – q – – –(4c)	1H111b^1 ♂ 50 p 37. 1. 2(3b)	1H149b^5 ♀ 00 p	– – –(alb.)
	a^5 – q – – –(5c)	a^6 – q – – –(5c)	... ...	... ...	... ...	... ...	... ...
2H126	a^1 55 q 46.46. 2(3c)	a^2 50 q 49. 1. 2(3c)	a^3 30 q 47. 1. 1(3c)	a^4 95 q 35.33. 1(4a)	1H164a^3 ♂ 00 p – – –(alb.)	1H136b^1 ♀ 90 p	39.35. 2(4a)
	a^5 – q – – –(5d)	... ...	... ...	... ...	... ...	... ...	... ...
2H127	a^1 ♀ 100xq 58.57.55(6e)	a^2 ♂ 100xq 56.55.55(5-6d-e)	a^3 80 q 48.35. 7(5c)	a^4 75 q 48.46. 2(4e)	1H165a^2 ♂ 00 p – – –(alb.)	1H136b^3 ♀ 100zp	37.35.28(5b)
	a^5 80 q 49.46. 7(5c)	... ...	... ...	... ...	... ...	... ...	... ...
2H129	a^1 – q – – –(5c)	a^2 – q – – –(2c)	... ...	... ...	1H144b^2 ♂ – q – – –(5c)	1H37a^3 ♀ – q	– – –(3c-dw)
2H135	a^1 – p – – –(5b)	a^2 – p – – –(5b)	a^3 – p – – –(5b)	a^4 – p – – –(5b)	1H99a^1 ♂ 100zp 39.35.28(6b)	1H129a^8 ♀ 100xp	24.23.15(6f)
	a^5 – p – – –(5b)	a^6 – p – – –(5b)	... ...	... ...	... ...	... ...	... ...
2H137	a^1 ♀ 35 p 37. 1. 1(2b)	a^2 ♀ 55 p 39.33. 1(3b)	a^3 35 p 37. 1. 1(2b)	a^4 – p – – –(2b)	1H70a^2 ♂ 55 q 37.33.30(3a)	1H136a^4 ♀ 35 p	39. 1. 1(2b)
2H139	a^1 100zq 39.33.28(5a ?)	a^2 100zq 39.33.28(5b ?)	a^3 100zq 48.46.12(5cw)	a^4 100xq 58.55.55(6e)	1H98a^3 ♂ 100zq 49.46. 4(6c)	1H136a^3 ♀ – q	– – –(5a)
	a^5 100xp 23.23.17(6fw)	... ...	... ...	... ...	... ...	... ...	... ...
2H142	a^1 ♀ 100xp 39.36.28(5bw)	a^2 100xp 39.39.28(5b–c)	a^3 – q – – –(5b–c)	a^4 – q – – –(5b–c)	1H148a^2 ♂ 80 q 49.46. 4(5c)	1H98a^5 ♀ 100zq	48.46. 4(5–6c)
	a^5 – q – – –(5c)	a^6 – q – – –(5c)	a^7 – q – – –(5c)	a^8 – q – – –(5cw)	... ...	... ...	... ...
2H143	a^1 100xq 58.58.55(6e)	a^2 30 q 61. 1. 1(3e)	a^3 100xq 58.58.57(6e)	a^4 35 p 26. 1. 1(2fw)	1H60a^1 ♂ 100xq 57.57.55(6e)	1H65b^1 ♀ – q	– – –(6e)
	a^5 100xq 58.57.55(6e)	a^6 100xp 23.23.18(6fw)	a^7 100xq 58.58.55(6e)	... ...	... ...	... ...	... ...
2H144	a^1 ♀ 60 q 58.56. 1(3e)	a^2 ♂ 80 q 58.57. 1(4e)	a^3 95 q 41.41.50(6g)	a^4 – q – – –(6g)	1H16a^1 ♂ 95 q 41.50. 4(4g)	1H157a^2 ♀ – q	– – –(5a)
	a^5 00 p – – –(alb.)	a^6 00 p – – –(alb.)	... ...	... ...	... ...	... ...	... ...
2H145	a^1 100zq 48.46.11(5c)	a^2 80 q 48.46.11(4c)	a^3 75 q 48.46. 3(3c)	a^4 00 p – – –(alb.)	1H111a^3 ♂ 100zq 48.46. 7(5c)	1H156a^1 ♀ 100xq	58.57.55(6e)
	a^5 00 p – – –(alb.)	... ...	... ...	... ...	... ...	... ...	... ...
2H146	a^1 60 q 49.48. 1(3c)	a^2 100zq 48.36.12(5c)	a^3 95 p 39.35.33(4b)	a^4 100zp 39.35.28(5b)	1H143a^1 ♂ 100zq 48.46. 2(5c)	1H158a^3 ♀ 100zq	49.48.34(5c)
	a^5 100xp 23.23.18(6f)	a^6 100xq 58.58.55(6e)	a^7 00 p – – –(alb.)	... ...	... ...	... ...	... ...
2H147	a^1 55 q ?39. 1. 2(3a)	a^2 100xq 41.41.50(6g)	a^3 55 p ?39. 1. 1(3a)	a^4 – q – – –(5a)	1H92a^3 ♂ 100xq 57.57.55(6e)	1H157a^1 ♀ – q	– – –(5a)
	a^5 00 p – – –(alb.)	a^6 00 p – – –(alb.)	a^7 00 p – – –(alb.)	a^8 00 p – – –(alb.)	... ...	... ...	... ...
2H148	a^1 100xp 37.36.36(5a)	a^2 100xp 43.47.46(5c)	a^3 100zq 49.46. 9(3c)	a^4 90 p 48.34. 2(4b–c)	1H161a^2 ♂ 100zq 48.46. 7(5c)	1H151a^4 ♀ 80 q	49.48.34(5c)
	a^6 100zq 48.46.30(5c)	a^6 80 p 36.36. 4(4b)	a^7 100zp 37.37. 2(5a)	a^8 80 p 37.37. 2(4a)	... ...	... ...	... ...
	a^9 – q – – –(3c)	... ...	... ...	... ...	... ...	... ...	... ...
2H151	a^1 100zp ?35.33.28(5a)	a^2 100zq 46.46. 2(5c)	a^3 100zq ?33.33.28(5a)	a^4 100zq ?33. 2. 2(5a)	1H99a^1 ♂ 100zp 39.35.28(6b)	1H97a^1 ♀ 100zq	33.30.28(5–6b)
	a^5 95 q 48.46.12(4c)	a^6 00 p – – –(alb.)	a^7 00 p – – –(alb.)	... ...	... ...	... ...	... ...
2H152	a^1 ♂ 60 q 58. 1. 1(2–3e)	a^2 ♂ 65 q 55. 1. 2(3–4e)	a^3 65 q 41. 1. 1(3g)	a^4 – q – – –(4c)	1H102b^1 ♂ 25 p 37. 1. 1(1–2b)	A43a^2 ♀ 00 p	– – –(A2 ?)
	a^5 – q – – –(3f–e)	... ...	... ...	... ...	... ...	... ...	... ...
2H153	a^1 100zq 46.46.30(5c)	... ...	... ...	... ...	1H128b^1 ♂ 100zp 35.35. 4(5–6b)	1H24a^1 ♀ 00 p	– – –(alb.)
2H154	a^1 50 q 48.46. 2(3c)	... ...	... ...	... ...	1H111b^1 ♂ 50 p 37. 1. 2(3b)	1H32a^1 ♀ 00 p	– – –(alb.)
2H155	a^1 ♂ 100xq 58.57.55(5–6e)	a^2 ♀ 100xq 58.57.56(6e)	a^3 ♀ 100xq 58.58.55(6e)	a^4 100zq 48.46.12(5c)	1H105a^4 ♂ 40 p 37. 1. 1(2b)	A58a^4 ♀ 00 p	– – –(A × 3)

MATING	OFFSPRING				PARENTS	
					Father	Mother
2*H*155	a^5 – *q* – – –(5*c*)					
2*H*156	a^1 ♀ *100xq* 58.56.56(6*e*)	a^2 ♂ *100xq* 56.56.56(6*e*)	a^3 ♂ *100xq* 58.57.55(6*e*)	a^4 ♂ *100xq* 57.56.56(6*e*)	1*H*139a^3 ♂ – *p* – – –(1–2*f*)	1*H*28b^4 ♀ *00 p* – – –(alb.)
	a^5 – *q* – – –(6*g*)					
2*H*157	a^1 *90 q* 48.46. 2(4*c*)	a^2 *100zq* 48.46.20(5*c*)	a^3 *100zq* 49.35.20(5*c*)	a^4 *95 q* 48.48.28(4*c*)	1*H*130b^3 ♂ *35 p* 39.35. 1(2*a*–*b*)	*A*30a^2 ♀ *00 p* – – –(*A*2 ?)
	a^5 *100zq* 48.46.20(5*c*)	a^6 *100zq* 48.46. 7(5*c*)	a^7 *100zq* 48.46. 9(5*c*)	a^8 *100zq* 48.46.20(4*c*)		
2*H*159	a^1 *100xp* 24.24.24(6*f*)	a^2 *100yp* 23.19. 9(5*bw*)	a^3 *100zp* 23.36.28(5*bw*)	a^4 – *p* – – –(3*f*)	1*H*111b^3 ♂ *60 q* 58.55. 1(3*e*)	1*H*3a^2 ♀ – *q* – – –(6*d*)
	a^5 *00 p* – – –(alb.)	a^6 *00 p* – – –(alb. *w*)	a^7 *00 p* – – –(alb.)			
2*H*300	a^1 ♀ *00 p* – – –(alb.)	a^2 ♀ *100xq* 58.57.56(6*e*)	a^3 ♂ *45 q* 61. 1. 1(2–3*e*)	b^1 ♀ *00 p* – – –(alb.)	1*H*139b^1 ♂ *100xq* 58.57.55(6*e*)	1*H*270a^1 ♀ *100xq* 58.58.55(6*e*)
	b^2 ♀ *00 p* – – –(alb.)	b^3 ♀ *100xq* 58.56.56(6*e*)	b^4 ♂ *00 p* – – –(alb.)	b^5 ♂ *00 p* – – –(alb.)	… … …	… … …
	c^1 ♂ *00 p* – – –(alb.)	c^2 ♀ *00 p* – – –(alb.)	c^3 ♀ *100xq* 58.56.56(6*e*)	c^4 ♀ *100xq* 57.56.55(6*e*)	… … …	… … …
	c^5 ♀ *100xq* 58.57.55(6*e*)	c^6 – *p* – – –	c^7 – *p* – – –			
2*H*301	a^1 ♂ *100xq* 58.58.55(6*e*)	a^2 ♂ *100xq* 58.57.55(6*d*–*e*)	a^3 ♂ *95 q* 58.55. 1(4*e*)	a^4 ♂ *100xp* 26.22.18(4–5*f*)	2*H*114a^1 ♂ *100zq* 58.58.55(6*e*)	1*H*274a^1 ♀ *100xq* 57.57.55(6*e*)
	a^5 ♀ *100xq* 58.57.55(6*e*)	a^6 ♀ *100xq* 58.57.56(5–6*e*)	a^7 ♀ *95 q* 58.55. 4(4–5*e*)	a^8 ♀ *100xp* 23.23. 8(5*f*)		
2*H*302	a^1 – *p* – – –(*f*)	a^2 – *q* – – –	a^3 – *p* – – –	b^1 ♂ *100xp* 23.15.15(6*f*)	2*H*114a^1 ♂ *100zq* 58.58.55(6*e*)	1*H*274a^2 ♀ *100xq* 58.57.55(6*e*)
	b^2 ♂ *100xq* 58.57.55(6*e*)	b^3 ♂ – *q* – – –(6*e*)	b^4 ♀ *95 q* 58.57.55(5*e*)	b^5 ♀ *100xq* 58.58.55(6*e*)	… … …	… … …
	b^6 ♀ *100xq* 58.57.55(6*e*)	b^7 – *q* – – –	b^8 – *p* – – –	c^1 ♀ *100xp* 23.23.15(6*f*)	… … …	… … …
	c^2 ♀ – *q* – – –(5*e*)	c^3 ♀ *60 q* 58.57. 1(4*e*)	c^4 ♀ *100xq* 58.57.55(6*e*)	c^5 ♀ *100xq* 58.58.55(6*e*)	… … …	… … …
	c^6 ♀ *100xq* 58.57.56(6*e*)	c^7 – *p* – – –	c^8 – *q* – – –			
2*H*303	a^1 ♂ *100xq* 58.57.55(6*e*)	a^2 ♂ – *q* – – –(4–5*e*)	a^3 ♂ *90 q* 58.55. 1(4*e*)	a^4 ♀ *100xq* 58.57.55(6*e*)	2*H*114a^1 ♂ *100zq* 58.58.55(6*e*)	1*H*274a^3 ♀ *100xq* 48.46.14(5–6*c*:*e*)
	b^1 ♂ – *p* – – –(6*f*)	b^2 ♂ *70 q* 58.55. 1(4*e*)	b^3 ♂ *90 q* 58.57. 1(5*e*)	b^4 ♂ *100xq* 58.58.55(5*e*)	… … …	… … …
	b^5 ♂ *100xq* 58.57.55(6*e*)	b^6 ♀ *100xq* 58.58.55(6*e*)	… … …	… … …	… … …	… … …
2*H*304	a^1 ♂ *100yp* 23.23.18(6*f*)	a^2 ♂ *80 p* 23.18. 4(4–5*f*)	a^3 ♂ *100xq* 58.58.55(6*e*)	a^4 ♀ *60 q* 58. 1. 1(3*e*)	2*H*114a^1 ♂ *100zq* 58.58.55(6*e*)	1*H*274a^4 ♀ *100xq* 58.58.55(6*e*)
	a^5 ♀ *85 q* 58.55. 2(4–5*e*)	a^6 ♀ *100xq* 58.58.55(6*e*)	a^7 – *q* – – –	a^8 – *q* – – –	… … …	… … …
	b^1 ♂ *100xq* 58.58.55(6*e*)	b^2 ♀ *100xq* 58.56.55(6*e*)	b^3 ♀ *100xq* 58.58.55(6*e*)	b^4 ♀ *85 q* 58.55. 2(5*e*)	… … …	… … …
	b^5 ♀ *100xp* 26.26.23(6*f*)	b^6 – *p* – – –	b^7 – *q* – – –	b^8 – *q* – – –	… … …	… … …
	c^1 ♂ *100xp* 26.26.17(6*f*)	c^2 ♀ *55 q* 58. 1. 1(3*e*)	c^3 ♀ *60 q* 61.58. 1(3*e*)	… … …	… … …	… … …
2*H*305	a^1 ♂ *100xp* 26.23.23(6*f*)	a^2 ♂ *35 p* 23. 1. 1(3*f*)	a^3 ♀ *100zp* 26.18.17(6*f*)	a^4 ♀ *100xp* 22.22.18(6*f*)	3*H*9a^1 ♂ – *p* – – –(6*f*)	1*H*234a^3 ♀ *100xp* 22.15.15(5–6*f*)
	a^5 ♀ *100xp* 23.23.18(6*f*)	a^6 ♀ *25 p* 23. 1. 1(2*f*)	a^7 – *p* – – –	b^1 ♂ *100xp* 26.23.18(5*f*)	… … …	… … …
	b^2 ♂ *100xp* 23.15.15(6*f*)	b^3 ♀ *100yp* 23.23.17(6*f*)	b^4 ♀ *30 p* 26. 1. 1(2*f*)	b^5 – *p* – – –	… … …	… … …
	c^1 ♂ *100xp* 23.23.15(5*f*)	c^2 ♀ *100yp* 26.23. 1(5*f*)	c^3 ♀ *100xp* 26.23.18(5*f*)	… … …	… … …	… … …
2*H*306	a^1 ♀ *100yp* 26.23. 2(5*f*)	a^2 ♀ *100xp* 23.23.17(6*f*)	b^1 ♀ *35 p* 23. 1. 1(2*f*)	b^2 ♂ *100xp* 23.23.15(5*f*)	1*H*234a^2 ♂ *100xp* 37.19. 9(5–6*f*)	1*H*227a^3 ♀ *60 p* 22. 1. 1(4*f*)
	b^3 ♂ *100xp* 23.23.18(5*f*)	b^4 ♂ *25 p* 26. 1. 2(2–3*f*)	b^5 – *p* – – –	b^6 – *p* – – –	… … …	… … …
	b^7 – *p* – – –	c^1 ♂ *55 p* 26.23. 1(3*f*)	c^2 ♀ *100xp* 23.23.18(6*f*)	c^3 ♀ *30 p* 26. 1. 3(1–2*f*)	… … …	… … …
2*H*307	a^1 ♂ – *p* – – –(5*b*)	a^2 ♀ *100zp* 39.35.30(5*b*)	a^3 ♀ *100xp* 39.39.36(5*b*)	a^4 ♂ – *p* – – –(5*b*)	1*H*123b^5 ♂ *100zp* 35.33.28(5–6*b*)	1*H*276a^2 ♀ *55 p* 37.39. 4(4*b*)
	a^6 – *p* – – –	a^7 – *p* – – –	a^8 – *p* – – –		… … …	… … …
2*H*308	a^1 ♂ *100xp* 35.35.30(5*b*)	a^2 ♂ *100zp* 39.35. 9(5–6*b*)	a^3 ♀ *100zp* 39.35. 9(5*b*)	a^4 ♀ *100xp* 39.35.30(5*b*)	1*H*123b^5 ♂ *100zp* 35.33.28(5–6*b*)	1*H*276a^3 ♀ *100zp* 35.35.28(5*b*)
	a^5 ♀ *95 p* 39.35. 2(5*b*)	a^6 ♀ *100zp* 36.35.30(5*b*–*f*)	… … …	… … …	… … …	… … …
2*H*309	a^1 ♂ – *p* – – –(5*b*)	a^2 ♂ – *p* – – –(5*b*)	a^3 ♀ *100zp* 39.39.28(5*b*)	a^4 ♀ *100zp* 39.35.28(5*b*)	1*H*130b^1 ♂ *30 p* 37. 1. 1(2*a*–*b*)	1*H*281a^1 ♀ *100zp* 39.39. 6(5*b*)
	a^5 – *p* – – –	a^6 – *p* – – –	a^7 – *p* – – –	a^8 – *p* – – –	… … …	… … …
	b^1 ♀ *100zp* 39.35.30(5*b*)	b^2 ♂ *100zp* 39.39.28(5*bw*)	b^3 ♂ *100zp* 40.36.28(5*b*)	b^4 – *p* – – –	… … …	… … …
	b^5 – *p* – – –	b^6 – *p* – – –	b^7 – *p* – – –	c^1 *100zp* 40.37. 4(5*b*)	… … …	… … …
	c^2 *100zp* 40.36. 4(5*b*)	c^3 *100zp* 37.37. 3(5*b*)	c^4 *100zp* 40.36. 4(5*b*)	c^5 – *p* – – –	… … …	… … …
	c^6 – *p* – – –	c^7 – *p* – – –	c^8 – *p* – – –			
2*H*310	a^1 ♀ *60 p* 37.19. 2(4*b*)	a^2 ♀ *80 p* 39.36. 4(5*b*)	a^3 ♂ *10 p* 37. 1. 1(2*b*)	a^4 ♂ *55 p* 37. 1. 1(3*b*)	1*H*130b^3 ♂ *35 p* 39.35. 1(2*a*–*b*)	1*H*283a^1 ♀ *80 p* 39.35. 2(5*b*)
	a^5 *60* 39. 1. 1 –	b^1 ♂ – *p* – – –(1–2*b*)	b^2 ♂ *65 p* 39. 1. 3(4*b*)	b^3 ♀ *75 p* 36.35. 4(5*a*–*b*)	… … …	… … …

	c^1 ♂ *15 p*37. 1. 1(1*b*)	... ...	... ...	... ...	... ...	... ...
2*H*312	a^1 ♂ *00 p*– – – –(alb.)	a^2 ♀ *00 p*– – – –(alb.)	a^3 ♀ *85 q*58.57. 2(4*e*)	a^4 ♀ *100xq*58.57.55(6*e*)	1*H*139b^1 ♂ *100xq*58.57.55(6*e*)	1*H*156a^1 ♀ *100xq*58.57.55(6*e*)
	a^5 ♀ *100xq*58.56.55(5–6*e*)	a^6 ♀ – *q*– – –(4*e*)	a^7 – *p*– – – –	b^1 ♂ – *q*– – –(6*e*)	... ...	... ...
	b^2 ♂ *00 p*– – –(alb.)	b^3 ♂ *100xq*58.57.55(6*e*)	b^4 ♀ *100xp*15.15.10(6*f*)	b^5 ♀ *00 p*– – –(alb.)	... ...	... ...
	b^6 ♀ – *q*– – –(6*e*)	b^7 – *q*– – –	c^1 ♂ *00 p*– – –(alb.)	c^2 ♂ *100xq*58.58.55(6*e*)	... ...	... ...
	c^3 ♂ *100xq*56.58.55(6*e*)	c^4 ♀ *90 q*58.57. 2(5*e*)	c^5 – *p*– – – –	c^6 – *p*– – – –	... ...	... ...
2*H*313	a^1 ♂ *00 p*– – –(alb.)	a^2 ♀ *35 q*58. 1. 1(3*e*)	b^1 ♂ *00 p*– – –(alb.)	b^2 ♀ *00 p*– – –(alb.)	1*H*225a^2 ♂ *85 q*57.55. 1(4*e*)	1*H*227a^6 ♀ *25 q*58. 1. 1(2*e*)
	b^3 ♀ *40 q*58. 1. 2(3*e*)	b^4 ♀ *00 p*– – –(alb.)	... ...	... ...	... ...	... ...
2*H*314	a^1 ♂ *00 p*– – –(alb.)	a^2 ♂ *35 p*37. 1. 1(3*b*)	a^3 ♂ *40 q*58. 1. 1(3*e*)	a^4 ♀ *35 q*58. 1. 1(2*e*)	1*H*109b^1 ♂ *25 q*58. 1. 2(2*e*)	1*H*187b^1 ♀ *55 q*58.57. 1(3*e*)
	b^1 ♂ *00 p*– – –(alb.)	b^2 ♂ – *q*– – –(2*e*)	b^3 ♀ *00 p*– – –(alb.)	c^1 ♂ *00 p*– – –(alb. *w*)	... ...	... ...
	c^2 ♀ *70 r*42.50. 1(3*g*)	... ...	... ...	... ...	... ...	... ...
2*H*315	a^1 ♀ *90 q*58.58. 2(4–5*e*)	b^1 ♂ *90 q*58.58. 1(4*e*)	b^2 ♂ – *q*– – –(4*e*)	b^3 ♀ *85 q*58.57. 1(3–4*e*)	1*H*232a^3 ♂ *65 q*58.57. 1(4*e*)	1*H*270a^2 ♀ *90 q*58.55. 2(4–5*e*)
	b^4 ♀ *85 q*58.55. 1(4*e*)	b^5 ♀ *00 p*– – –(alb.)	b^6 ♀ – *q*– – –(5*e*)	b^7 – *q*– – – –	... ...	... ...
	c^1 ♀ *70 q*58. 1. 4(3–4*e*)	c^2 ♀ *85 q*58.57. 3(4*e*)	c^3 ♂ *65 q*58.57. 1(3*e*)	c^4 ♂ – *q*– – –(4*e*)	... ...	... ...
	c^5 ♂ *65 q*58.58. 1(3*e*)	... ...	... ...	... ...	... ...	... ...
2*H*317	a^1 *65 p*26. 1. 1(3–4*f**)	a^2 *30 p*37. 1. 1(2*b*–*f**)	... ...	... ...	1*H*102b^1 ♂ *25 p*37. 1. 1(1–2*b*)	1*H*232a^3 ♀ *55 p*39.39. 2(3*b*)
3*H*1	a^1 ♂ *60 q*58.57. 1(3*e*)	a^2 ♂ *50 r*42.50. 1(3*g*)	a^3 ♀ *55 p*26.26. 1(3*f*)	a^4 ♀ *100xp*26.26.23(6*f*)	2*H*114a^1 ♂ *100xq*58.58.55(6*e*)	2*H*124a^1 ♀ *100xq*58.57.56(6*e*)
	a^5 ♀ *100xp*26.23.18(6*f*)	a^6 ♀ *45 q*58.55. 1(3*e*)	a^7 ♂ *55 p*26.17. 3(3*f*)	a^8 ♀ *100xq*58.57.55(6*e*)	... ...	... ...
	b^1 ♂ *65dr*41.50. 3(4*g*)	b^2 ♂ *55 q*58. 1. 1(4*e*)	b^3 ♂ *100xq*57.57.56(5–6*e*)	b^4 ♂ *100xq*58.58.56(6*e*)	... ...	... ...
	b^5 ♀ *45 q*55.56. 3(3*e*)	b^6 ♀ *60d.r*41.41. 3(4*g*)	b^7 ♀ – *q*– – –(5–6*e*)	b^8 – *q*– – – –	... ...	... ...
	b^9 – *q*– – – –	b^{10} – *p*– – – –	c^1 ♂ *100xp*22.22.17(6*f*)	c^2 ♂ *70 q*58.58. 2(4*e*)	... ...	... ...
	c^3 ♂ *100xr*41.41.50(6*g*)	c^4 ♂ *100xr*{ or *q*} 41.41.50(6*g*)	c^5 ♂ *100xq*58.58.55(6*e*)	c^6 ♀ *65 q*58.55. 2(4*e*)	... ...	... ...
	c^7 ♀ *100xq*58.58.56(6*e*)	c^8 – *q*– – – –	c^9 – *q*– – – –	c^{10} – *q*– – – –	... ...	... ...
	c^{11} – *p*– – – –	c^{12} – *p*– – – –	... ...	... ...	... ...	... ...
3*H*2	a^1 ♂ *00 p*– – –(alb.)	a^2 ♂ *85 q*58.55. 2(4*e*)	a^3 ♂ *100xq*57.57.55(5*e*)	a^4 ♂ *100xq*58.58.55(5–6*e*)	2*H*155a^1 ♂ *100xq*58.57.55(5–6*e*)	2*H*156a^1 ♀ *100xq*58.56.56(6*e*)
	a^5 ♀ *00 p*– – –(alb.)	a^6 ♀ *75 q*55. 1. 1(4*e*)	a^7 ♀ *100xq*56.57.55(5–6*e*)	b^1 ♂ *00 p*– – –(alb.)	... ...	... ...
	b^2 ♂ *00 p*– – –(alb. *w*)	b^3 ♂ *100xp*22.17.18(6*f*)	b^4 ♂ *100xq*57.56.55(5–6*e*)	b^5 ♀ *100xp*22.15.18(6*f*)	... ...	... ...
	c^1 ♂ *100xq*58.58.55(6*e*)	c^2 ♂ *00 p*– – –(alb.)	c^3 ♀ *00 p*– – –(alb.)	... ...	... ...	... ...
3*H*3	a^1 ♂ *55 q*58.56. 1(4*ew*)	a^2 ♂ *60 p*23. 1. 1(3*f*)	a^3 ♀ *100xq*58.58.55(5–6*e*)	a^4 ♂ *100xq*58.58.55(6*e*)	2*H*156a^2 ♂ *100xq*56.56.56(6*e*)	2*H*155a^2 ♀ *100xq*58.57.56(6*e*)
	a^5 ♀ *100xq*56.56.55(6*e*)	a^6 ♀ *00 p*– – –(alb.)	a^7 ♀ *00 p*– – –(alb.)	a^8 ♀ *100xp*15.15.15(6*f*)	... ...	... ...
	a^9 – *p*– – – –	b^1 ♂ *00 p*– – –(alb.)	b^2 ♂ *75 q*58.55.55(4*e*)	b^3 ♂ – *q*– – –(4*e*)	... ...	... ...
	b^4 ♂ *100xq*58.57.55(6*e*)	b^5 ♂ *100xq*58.57.55(6*e*)	b^6 ♂ *100xq*57.57.56(5*e*)	b^7 ♂ *100xq*58.58.55(6*e*)	... ...	... ...
	b^8 ♀ *100yp*23.23.18.6*f*(*w*)	b^9 ♀ *100xq*58.58.55(6*e*)	c^1 ♂ – *p*– – –(6*f*)	c^2 ♂ *100xq*57.58.56(6*e*)	... ...	... ...
	c^3 ♂ *00 p*– – –(alb. *w*)	c^4 ♂ *00 p*– – –(alb.)	c^5 ♀ *60 p*26.22. 2(3*f*)	c^6 ♀ *00 p*– – –(alb.)	... ...	... ...
	c^7 ♀ *00 p*– – –(alb.)	c^8 – *p*– – – –	c^9 – *p*– – – –	c^{10} – *p*– – – –	... ...	... ...
3*H*4	a^1 ♂ – *p*– – –(6*f*)	a^2 ♂ – *q*– – –(6*e*)	a^3 ♀ *100xp*23.22.18(6*f*)	a^4 ♀ *100xp*23.23.17(6*f*)	2*H*156a^3 ♂ *100xq*58.57.55(6*e*)	2*H*155a^3 ♀ *100xq*58.58.55(6*e*)
	a^5 ♀ *100xq*57.57.56(6*e*)	a^6 ♀ *100xq*58.57.55(6*e*)	b^1 ♂ – *q*– – –(5*e*)	b^2 ♂ *100xq*58.58.55(6*e*)	... ...	... ...
	b^3 ♂ *100xq*58.58.55(6*e*)	b^4 ♂ *00 p*– – –(alb.)	b^5 ♀ *85 q*57.57. 2(4*e*)	b^6 ♀ *00 p*– – –(alb.)	... ...	... ...
	b^7 – *p*– – – –	c^1 ♂ *00 p*– – –(alb.)	c^2 ♂ *00 p*– – –(alb.)	c^3 ♂ *100xp*23.22.17(5*a*–*f*)	... ...	... ...
	c^4 ♂ *45 q*58.58. 1(2–3*e*)	c^5 ♂ *95 q*58.55. 2(5*e*)	c^6 – *p*– – – –	c^7 ♀ – *q*– – –(6*e*)	... ...	... ...
	c^8 ♀ *100xq*58.57.55(6*e*)	c^9 ♀ *80 q*58.57. 2(4*e*)	... ...	... ...	... ...	... ...
3*H*5	a^1 ♂ *100xq*41.41.50(6*g*)	a^2 ♂ *100xq*58.58.55(6*e*)	a^3 ♂ *100xq*57.57.55(6*e*)	a^4 ♂ *100xq*58.58.55(6*e*)	2*H*49a^1 ♂ – *q*– – –(6*e*)	2*H*108a^1 ♀ *100xq*58.57.56(6*e*)
	a^5 ♀ *00 p*– – –(alb.)	a^6 ♀ *00 p*– – –(alb.)	b^1 ♂ *00 p*– – –(alb. *w*)	b^2 ♂ *100xq*41.50.26(6*gw*)	... ...	... ...
	b^3 ♂ *100xq*58.58.55(6*e*)	b^4 ♂ – *q*– – –(6*e*)	b^5 ♀ *75 r*41.41. 3(4*gw*)	b^6 ♀ *90 q*58.58. 2(4*e*)	... ...	... ...
	b^7 ♀ *100xq*56.57.55(6*ew*)	c^1 ♀ *100xq*58.58.55(5*e*)	c^2 ♂ – *q*– – –(6*e*)	c^3 ♂ *00 p*– – –(alb.)	... ...	... ...
	c^4 ♀ – *q*– – –(5*g*)	c^5 ♀ *100xq*57.57.56(6*e*)	... ...	... ...	... ...	... ...
3*H*6	a^1 ♂ *00 p*– – –(alb.)	a^2 ♂ *100yq*58.57. 2(5*e*)	a^3 ♂ *100xq*57.57.56(5–6*e*)	a^4 ♀ *100yq*58.58.55(5*e*)	2*H*96a^1 ♂ *100xq*58.57.55(6*e*)	2*H*119a^1 ♀ *100xq*58.58.55(6*e*)

Mating	Offspring				Parents	
					Father	Mother
3*H*6	b^1 ♀ *100xq*58.58.55(6*e*)	b^2 ♀ *100xq*58.58.55(5–6*e*)	b^3 ♀ *100xq*56.57.55(5–6*e*)	b^4 ♂ *100xq*58.57.55(5–6*e*)	... ...	... ...
	b^5 ♂ *100xq*57.57.56(5*e*)	b^6 ♂ *00 p* – – –(alb.)	b^7 – *q* – – –	c^1 ♂ *100xq*58.58.55(5*e*)	... ...	... ...
	c^2 ♂ *100xq*58.57.55(5*e*)	c^3 ♂ *100xq*58.58.55(5*e*)	c^4 ♀ – *q* – – –(5*e*)	c^5 ♀ *00 p* – – –(alb.)	... ...	... ...
	c^6 – *p* – – – –	... ...	... ...	... ...	... ...	... ...
3*H*7	a^1 ♂ – *q* – – –(6*e*)	a^2 ♀ *35 q*61. 1. 3(3*e*)	a^3 ♀ *100xq*58.58.55(6*e*)	a^4 ♀ *100xq*58.58.55(6*e*)	2*H*96a^1 ♂ *100xq*58.57.55(6*e*)	2*H*119a^2 ♀ *100xq*58.58.55(6*e*)
	a^5 ♀ *100xq*58.58.55(6*e*)	b^1 ♂ – *q* – – –(5–6*e*)	b^2 ♂ *100xq*58.58.55(5–6*e*)	b^3 ♂ – *q* – – –(4*e*)	... ...	... ...
	b^4 ♂ *100xp*23.23.17(6*f*)	b^5 ♀ *100xq*58.57.55(5*e*)	b^6 ♀ *90 p*26.23. 4(5*f*)	b^7 – *q* – – –	... ...	... ...
3*H*8	a^1 ♂ *00 p* – – –(alb.)	a^2 ♀ *35 r*41.41. 3(2–3*g*)	a^3 ♀ *100xq*57.58.55(5*e*)	a^4 – *q* – – –	2*H*49a^2 ♂ *100xq*58.57.55(6*e*)	2*H*123a^1 ♀ *100xq*58.58.56(6*e*)
	a^5 – *q* – – – –	... ...	... ...	... ...	... ...	... ...
3*H*9	a^1 ♂ – *p* – – –(6*f*)	a^2 ♂ *100xq*58.58.55(5*e*)	a^3 ♂ *100xq*58.58.55(6*e*)	a^4 ♀ *00 p* – – –(alb.)	2*H*102a^1 ♂ *100xq*58.57.55(6*e*)	2*H*80a^1 ♀ *100xq*58.57.56(6*e*)
	a^5 ♀ – *q* – – –(4*e*)	b^1 ♂ *00 p* – – –(alb.)	b^2 ♂ *00 p* – – –(alb.)	b^3 ♂ *00 p* – – –(alb.)	... ...	... ...
	b^4 ♂ *40* q58. 1. 3(3*e*)	b^5 ♀ *00 p* – – –(alb.)	b^6 ♀ *00 p* – – –(alb.)	b^7 – *p* – – –	... ...	... ...
	c^1 ♀ *100xq*58.58.56(6*e*)	c^2 ♀ *100xq*58.58.55(5*e*)	... ...	... ...	... ...	... ...
3*H*10	a^1 *100xq*41.41.50(6*f*)	a^2 *100xq*41.41.50(6*gw*)	a^3 – *q* – – –(6*e*)	a^4 – *q* – – –(3*e*)	2*H*108a^2 ♂ *100xq*58.56.56(6*ew*)	2*H*49a^3 ♀ *100xq*58.57.55(6*e*)
	a^5 *00 p* – – –(alb.)	a^6 *00 p* – – –(alb. *w*)	a^7 – *q* – – –	b^1 *00 p* – – –(alb. *w*)	... ...	... ...
	b^2 *00 p* – – –(alb.)	b^3 *100xq*58.58.55(6*ew*)	b^4 *00 p* – – –(alb. *w*)	b^5 *100xq*58.58.55(5*e*)	... ...	... ...
	c^1 ♂ *100xq*58.58.55(6*e*)	c^2 ♂ *100x* ?41.41.26(6*g*)	c^3 ♀ *100xq*58.58.54(6*e*)	c^4 ♀ – *q* – – –(3*e*)	... ...	... ...
	c^5 ♀ *00 p* – – –(alb.)	c^6 – *p* – – – –	... ...	... ...	... ...	... ...
3*H*11	a^1 ♂ *100xq*57.57.55(5–6*e*)	a^2 ♀ *100xp*23.22.17(5*f*)	a^3 ♀ *00 p* – – –(alb.)	a^4 ♀ *100xq*58.58.55(6*e*)	2*H*117a^1 ♂ – *q* – – –(6*e*)	2*H*127a^1 ♀ *100xq*58.57.55(6*e*)
	a^5 ♀ *100xq*57.57.56(5–6*e*)	a^6 ♀ *100xq*58.58.55(5–6*e*)	a^7 ♀ *100xq*57.57.56(5–6*e*)	a^8 – *p* – – –	... ...	... ...
	b^1 ♂ *100xp*22.22.15(6*f*)	b^2 ♀ *00 p* – – –(alb.)	... ...	... ...	... ...	... ...
3*H*12	a^1 *100xq*58.58.55 –	a^2 *85 q* 58.55. 2 –	a^3 *15 p*23. 1. 1 –	a^4 *40 p*23.18. 2 –	2*H*127a^2 ♂ *100xq*56.55.55(5–6*d–e*)	2*H*103a^1 ♀ – *q* – – –(4–5*e*)
	a^5 *85 q*58.57. 2 –	a^6 – *q* – – – –	a^7 – *q* – – – –	a^8 – *p* – – – –	... ...	... ...
	a^9 – *p* – – – –	a^{10} – *p* – – – –	b^1 – *q* – – – –	b^2 – *p* – – – –	... ...	... ...
	c^1 – *q* – – – –	c^2 – *q* – – – –	c^3 – *q* – – – –	c^4 – *p* – – – –	... ...	... ...
	c^5 – *p* – – – –	... ...	... ...	... ...	... ...	... ...
3*H*13	a^1 ♂ *75* q58.55. 2(3*e*)	a^2 ♀ *80 r* 41.50. 1(4*g*)	a^3 ♀ *90 p*37.19. 1(5*b*)	a^4 ♀ *60* q58.58. 1(3–4*e*)	2*H*124a^2 ♂ *85* q58.55. 2(4*e*)	2*H*96a^2 ♀ *50* q58.58. 2(3*e*)
	b^1 ♂ *60* q58.55. 2(3*e*)	b^2 ♀ *70 q*58. 1. 1(4*e*)	b^3 ♀ – *r* – – –(4*g*)	b^4 ♀ *00 p* – – –(alb.)	... ...	... ...
	b^5 – *p* – – – –	... ...	... ...	... ...	... ...	... ...
3*H*14	a^1 ♂ *00 p* – – –(alb.)	a^2 ♂ *00 p* – – –(alb.)	a^3 ♀ *00 p* – – –(alb.)	a^4 ♂ *70* q45. 1. 2(4*ch*)	2*H*152a^2 ♂ *65* q55. 1. 2(3–4*e*)	2*H*144a^1 ♀ *60* q58.56. 1(3*e*)
	a^5 ♀ – *q* – – –(5*ch*)	b^1 ♂ *65* q58.58. 2(4*e*)	b^2 ♂ *00 p* – – –(alb.)	b^3 ♀ *50* q58. 1. 2(3–4*e*)	... ...	... ...
	b^4 ♀ *65* q57. 1. 1(4*ch*)	b^5 ♀ *00 p* – – –(alb.)	b^6 ♀ *00 p* – – –(alb.)	c^1 ♂ *40* q45. 1. 2(3*ch*)	... ...	... ...
	c^3 – *p* – – – –	c^3 – *q* – – – –	c^4 – *q* – – – –	c^5 – *q* – – – –	... ...	... ...
	c^6 – *q* – – – –	c^7 – *q* – – – –	c^8 – *q* – – – –	... ...	... ...	... ...
3*H*15	a^1 ♂ *00 p* – – –(alb.)	a^2 ♂ *00 p* – – –(alb.)	a^3 ♂ *35* q58.55. 2(2–3*e*)	a^4 ♂ *65* q58. 1. 2(3*e*)	2*H*144a^2 ♂ *80* q58.57. 1(4*e*)	2*H*111a^1 ♀ *60* q58. 1. 3(4*e*)
	a^5 ♂ *55* q58.58. 3(3–4*e*)	a^6 ♂ *65* q57.55. 3(4*e*)	a^7 ♂ *55* q58. 1. 3(3–4*e*)	a^8 ♀ *65* q58.58. 2(4*e*)	... ...	... ...
	b^1 ♂ *75* q58.58. 1(4*e*)	b^2 ♂ *75* q58.55. 4(4*e*)	b^3 ♂ – *q* – – –(4*e*)	b^4 ♂ *00 p* – – –(alb.)	... ...	... ...
	b^5 ♀ *75* q58.58. 2(4–5*e*)	b^6 ♀ *00 p* – – –(alb.)	c^1 ♂ *60* q58. 1. 1(4*e*)	c^2 ♂ *65* q58.58. 2(4*e*)	... ...	... ...
	c^3 ♂ *50* q58. 1. 2(3*e*)	c^4 ♂ *80* q58. 1. 1(2–3*e*)	c^5 ♀ *75* q58.58. 3(4*e*)	c^6 ♀ *60* q58. 1. 3(4*e*)	... ...	... ...
	c^7 ♀ – *q* – – –(3*e*)	c^8 – *q* – – – –	... ...	... ...	... ...	... ...
3*H*16	a^1 ♂ *80* q58.57. 2(4*e*)	a^2 ♂ *70* q58.58. 2(4*e*)	a^3 ♀ *65 p*26. 1. 2(3*f*)	a^4 ♀ *40 p*26.17. 1(3*f*)	2*H*103a^2 ♂ *70* q58.55. 1(4*e*)	2*H*108a^3 ♀ *55* q58.55. 3(3–4*e*)
	a^5 ♀ *40* q61. 1. 3(3*e*)	a^6 ♀ *80* q57.57. 1(4*e*)	a^7 – *p* – – – –	b^1 ♀ *85* q56.55. 3(4–5*e*)	... ...	... ...
	b^2 ♀ *65* q56.58. 1(4*e*)	b^3 ♀ *00 p* – – –(alb.)	b^4 – *q* – – – –	... ...	... ...	... ...
3*H*17	a^1 ♀ *85* q58.58. 4(4–5*e*)	... ...	... ...	... ...	2*H*152a^1 ♂ *60* q58. 1. 1(2–3*e*)	2*H*115a^1 ♀ – *q* – – –(4*e*)
3*H*19	a^1 ♀ *60 p*39.39. 3(3*b*)	b^1 ♀ *100xp*39.39.34(6*b*)	b^2 ♀ – *p* – – –(5*b*)	b^3 ♀ – *p* – – –(5*b*)	2*H*116a^1 ♂ *100xp*39.35.28(5*b*)	2*H*12a^3 ♀ *100xp*39.39.34(5*b–c*)

3*H*19	a^1 ♀ *60 p39.39. 3(3b)*	b^1 ♀ *100xp39.39.34(6b)*				

3*H*20	a^1 ♂ *75 p36.35. 4(5b)* a^5 ♀ *100xp35.35.28(6b)*	a^2 ♂ *80 p36.36. 4(5b)* a^6 – *p – – – –*	a^3 ♀ – *p – – –(5b)* a^7 – *p – – – –*	a^4 ♀ *100xp39.35.28(5b)* … … …	2*H*93b^1 ♂ *100xp35.35.28(5b)* … … … …	2*H*116a^2 ♀ *100xp35.35.30(5–6b)* … … … …
3*H*21	a^1 ♂ *80 p39.35. 2(5b)* a^5 ♀ *100xp39.39.28(5b)*	a^2 ♂ *80 p39.35. 2(5b)* a^8 ♀ *100xp39.39.30(5–6b)*	a^3 ♀ *75 p39.39. 4(5b)* a^7 – *p – – – –*	a^4 ♀ *80 p39.39. 4(5b)* a^8 – *p – – – –*	2*H*116a^3 ♂ – *p – – –(5b)* … … … …	2*H*117a^2 ♀ *80 p39.39. 2(5b)* … … … …
3*H*24	a^1 ♀ – *p – – –(2bw)*	a^2 ♀ *35 p24. 1. 3(3f)*	a^3 – *p – – – –*	a^4 – *p – – – –*	2*H*85a^3 ♂ *30 p37. 1. 1(2–3b)*	2*H*137a^1 ♀ *35 p37. 1. 1(2b)*
3*H*25	a^1 ♂ – *p – – –(2b)* a^5 ♂ *55 p37.35.30(3b)* b^1 ♂ *45 p39. 1. 3(3b)* b^5 ♂ *25 p19. 1. 1(2b)* b^9 ♀ *10 p35. 1. 2(1b)*	a^2 ♂ *25 p37. 1. 3(2b)* a^6 ♀ *30 p19. 1. 1(2b)* b^2 ♂ *25 p38. 1. 2(3b)* b^6 ♀ – *p – – –(3b)* c^1 ♂ *35 p37. 1. 4(2b)*	a^3 ♂ *40 p37. 1. 1(2b)* a^7 ♀ – *p – – –(2b)* b^3 ♂ *70 p37. 1. 1(4b)* b^7 ♀ *40 p39.39.28(3b)* c^2 ♀ *25 p39. 1. 2(1–2b)*	a^4 ♂ *50 p37. 1. 3(3b)* a^8 ♀ *45 p39. 1. 4(2b)* b^4 ♂ – *p – – –(1b)* b^8 ♀ *25 p37. 1. 3(2b)* … … …	2*H*85a^3 ♂ *30 p37. 1. 1(2–3b)* … … … … … … … … … … … … … … … …	2*H*137a^2 ♀ *55 p39.33. 1(3b)* … … … … … … … … … … … … … … … …
3*H*26	a^1 ♂ *15 p37. 1. 4(2b)*	a^2 ♂ *20 p37. 1. 2(2b)*	a^3 ♂ *30 p39. 1. 1(3b)*	… … …	2*H*85a^4 ♂ *45 p37. 1. 1(2–3b)*	2*H*55a^1 ♀ *25 p39. 1. 4(1–2a–b)*
3*H*27	a^1 ♂ *25 p36. 1. 2(2b)*	a^2 ♂ *30 p39. 1. 2(2b)*	b^1 ♂ *30 p39. 1. 1(2b)*	b^2 ♂ *20 p37. 1. 1(2b)*	2*H*85a^4 ♂ *45 p37. 1. 1(2–3b)*	2*H*55a^2 ♀ *35 p39.39. 3(2a–b)*
3*H*28	a^1 ♀ *45 p39.39. 3(3b)* a^5 – *p – – – –*	a^2 ♀ *15 p39. 1. 2(1b)* b^1 – *p – – – –*	a^3 – *p – – – –* b^2 – *p – – – –*	a^4 – *p – – – –* b^3 – *p – – – –*	2*H*55a^3 ♂ *10 p37. 1. 1(1a–b)* … … … …	2*H*15a^4 ♀ *40 p39.35. 1(3b)* … … … …
3*H*29	a^1 ♂ *35 p39. 1. 1(2b)* b^1 ♂ *40 p36.36. 1(3b)* b^5 ♀ *40 p39. 1. 1(2b)* c^4 ♀ *45 p37. 1. 2(3b)*	a^2 ♂ *70 p37.39. 3(3–4b)* b^2 ♂ *55 p39.39. 1(4b)* c^1 ♂ *20 p23. 1. 2(2f)* c^5 ♀ – *p – – –(2–3b)*	a^3 ♂ – *p – – –(3–4f)* b^3 ♀ *50 p39.39. 3(3b)* c^2 ♀ *70 p26. 1. 2(4f)* … … …	a^4 ♀ *40 p37.39. 3(2–3b)* b^4 ♀ *55 p37.35. 3(3b)* c^3 ♀ *60 p39. 1. 2(4b)* … … …	2*H*55a^3 ♂ *10 p37. 1. 1(1a–b)* … … … … … … … … … … … …	2*H*15a^1 ♀ *80 p36. 1. 3(4b)* … … … … … … … … … … … …
3*H*30	a^1 ♂ *45 p23. 1. 2(2f)*	a^2 ♂ *40 p40. 1. 2(2b)*	a^3 ♀ *55 p35.35. 2(2b)* … … …	… … …	2*H*85a^5 ♂ *30 p36. 1. 2(2–3b)*	2*H*11a^2 ♀ – *p – – –(2–3b)*
3*H*31	a^1 ♂ *100xq58.58.55(6e)* a^5 ♀ *100xq49.48.46(6c)* b^1 ♀ *100xp10.10.10(6f)* b^5 ♂ *100xp39.35.34(6b)* c^1 ♂ – *q – – –(6c)*	a^2 ♂ – *q – – –(6c)* a^6 ♀ *100xq49.48.46(6c)* b^2 ♀ – *q – – –(3e)* b^6 ♂ *100xq49.48.46(6c)* c^2 ♂ *95 q49.47. 2(5c)*	a^3 ♂ *100xq51.46.47(6c)* a^7 ♀ *80 q56.57. 1(4e)* b^3 ♀ *75 q49. 1. 1(4–5c)* b^7 ♂ *100xq49.48.46(6c)* c^3 ♂ *100xq49.48.46(6c)*	a^4 ♂ *85 p36.36. 1(4b)* a^8 ♀ *100xp39.39.38(6b)* b^4 ♀ *70 q49.46. 4(4–5c)* b^8 ♂ *100xq49.48.46(6c)* c^4 ♂ *100xq 49.48.46(6c)*	2*H*13a^1 ♂ *100xp26.23.18(6f)* … … … … … … … … … … … … … … … …	*Z*139 ♀ *00 p – – –(A1)* … … … … … … … … … … … … … … … …
3*H*33	a^1 ♂ *100xq58.57.55(6e)* a^5 ♀ *100xq58.58.57(6e)* b^3 ♂ *60 q58.57. 1(4e)* b^7 ♀ *100xq58.58.55(6e)* c^3 ♂ *100xq58.58.55(6e)* c^7 ♂ *100xq57.57.56(6e)*	a^2 ♂ *100xq58.57.55(6e)* a^6 ♀ *100xq58.58.55(6e)* b^4 ♀ *70 q58.57. 2(4e)* b^8 ♀ *100xq58.58.55(6e)* c^4 ♀ *100xq58.58.55(6e)* c^8 ♂ *100xq58.58.56(6e)*	a^3 ♂ *100xq58.57.55(6e)* b^1 ♂ *100xq58.58.55(6e)* b^5 ♀ *80 q58.56. 1(4e)* c^1 ♂ *100xq58.58.55(6e)* c^5 ♀ *100xq58.58.55(6e)*	a^4 ♂ *100xq58.57.55(6e)* b^2 ♂ *85 q58.57. 1(4e)* b^6 ♀ *100xq58.58.55(6e)* c^2 ♂ *100xq58.58.55(6e)* c^6 ♀ *100xq58.58.55(6e)*	2*H*13a^3 ♂ *100xp22.23.17(6f)* … … … … … … … … … … … … … … … …	*Z*173 ♀ *00 p – – –(A1)* … … … … … … … … … … … … … … … …
3*H*37	a^1 ♂ – *p – – –(5b)* a^5 ♀ *80 p39.39.28(5b)*	a^2 ♂ *85 p35.35. 4(5b)* a^6 ♀ *80 p35.35.28(5b)*	a^3 ♂ *80 p36.35. 3(5b)* … … …	a^4 ♀ *100zp35.33.28(5a)* … … …	2*H*116a^3 ♂ – *p – – –(5b)* … … … …	1*H*269a^2 ♀ *100zp33.30.30(5a–b)* … … … …
3*H*38	a^1 *85 q58.55. 4(4e)* a^5 ♀ *00 p – – –(alb.)* b^4 ♀ *75 q58.57. 2(4e)* c^1 ♂ – *q – – –(3e)* c^5 ♀ *00 p – – –(alb.)*	a^2 ♂ *75 q61.58. 2(4e)* b^1 ♂ *00 p – – –(alb.)* b^5 ♀ *85 q57.55. 4(4e)* c^2 ♂ *40 q58. 1. 1(3e)* c^6 ♀ *00 p – – –(alb.)*	a^3 ♀ *00 p – – –(alb.)* b^2 ♂ *00 p – – –(alb.)* b^6 ♀ *80 q57.55. 6(4e)* c^3 ♂ *90 q58.55. 1(5e)* c^7 – *p – – – –*	a^4 ♀ *00 p – – –(alb.)* b^3 ♀ *75 q58.57. 3(4e)* b^7 ♀ – *q – – –(4e)* c^4 ♂ *00 p – – –(alb.)* … … …	2*H*144a^2 ♂ *80 q58.57. 1(4e)* … … … … … … … … … … … … … … … …	2*H*80a^2 ♀ *60 q58. 1. 1(3–4e)* … … … … … … … … … … … … … … … …
3*H*39	a^1 ♂ – *p – – –(5b)* b^1 ♂ – *q – – –(1e)*	a^2 ♂ – *p – – –(2b)* b^2 ♂ *00 p – – –(alb.)*	a^3 ♂ *00 p – – –(alb.)* b^3 ♀ *00 p – – –(alb.)*	a^4 ♀ *00 p – – –(alb.)* … … …	2*H*127a^2 ♂ *100xq56.55.55(5–6d–e)* … … … …	1*H*115b^2 ♀ – *q – – –(4e)* … … … …
3*H*40	a^1 ♂ *70 p50.50. 1(4f)* a^5 *85 p23.23. 2(5f)* b^4 ♀ *85 q57.55. 1(4e)*	a^2 ♂ – *q – – –(4e)* b^1 ♂ *90 q58.55. 2(4e)* b^5 ♀ *90 q58.45. 1(4e)*	a^3 ♀ *70 q58.57. 1(4e)* b^2 ♂ *80 q58.58.55(4–5e)* b^6 ♀ *85 q58.56. 2(4–5e)*	a^4 ♀ *90 q58.58. 1(5e)* b^3 ♂ *95 q58.55. 2(4–5e)* b^7 ♀ *65 q58.57. 2(3e)*	2*H*124a^2 ♂ *85 q58.55. 2(4e)* … … … … … … … …	1*H*231a^7 ♀ *85 q57.55. 1(4–5e)* … … … … … … … …
3*H*42	a^1 – *p – – – –* b^3 – *p – – – –*	a^2 ♂ *55 p23.23. 1(2–3f)* c^1 ♂ *50 p35. 1. 3(3–4b)*	c^2 – *p – – – –*	b^2 ♀ *100xp15.15.17(6f)* … … …	2*H*93b^1 ♂ *100zp35.35.28(5b)* … … … …	1*H*121b^2 ♀ *75 p39.34. 1(4a–b)* … … … …
3*H*44	a^1 ♂ *100xq58.58.55(6e)* a^5 ♀ *100xq58.58.57(6e)* b^4 ♀ *100xq58.58.57(6e)* c^3 ♂ *100xq58.58.55(6e)*	a^2 ♂ – *q – – –(6e)* b^1 ♂ *100xq58.58.57(6e)* b^5 – *q – – – –* c^4 ♀ – *q – – –(6e)*	a^3 ♂ – *q – – –(6e)* b^2 ♂ *100xq58.58.55(6e)* c^1 ♂ *100xq58.58.55(6e)* c^5 ♀ *100xq58.58.55(6e)*	a^4 ♀ *100xq58.58.55(6e)* b^3 ♀ *100xq58.58.55(6e)* c^2 ♂ – *q – – –(6e)* c^6 – *p – – – –*	2*H*301a^1 ♂ *100xq58.58.55(6e)* … … … … … … … … … … … …	2*H*303a^4 ♀ *100xq58.57.55(6e)* … … … … … … … … … … … …

MATING	OFFSPRING				PARENTS	
					Father	Mother
3*H*44	*c*⁷ – *p* – – – –	*c*⁸ – *p* – – – –	... ...	... ...	... ...	... ...
3*H*45	*a*¹ ♂ *00 p* – – – (alb. *w*)	*a*² ♂ *100xq*58.57.55(6*e*)	*a*³ ♀ *100xq*58.58.55(6*e*)	*a*⁴ ♀ *100xq*58.58.55(6*e*)	2*H*301*a*² ♂ *100xq* 58.57.55(6*d*–*e*)	2*H*300*a*² ♀ *100xq*58.57.56(6*e*)
	*a*⁵ ♀ *100xq*58.58.55(6*e*)	*a*⁶ ♀ *100xp*22.22.17(6*f*)	*a*⁷ – *q* – – – –	*a*⁸ – *p* – – – –	... ...	... ...
	*b*¹ ♂ *100xq*58.58.55(6*e*)	*b*² ♂ *100xq*58.58.55(6*e*)	*b*³ ♂ *100xq*58.57.55(6*e*)	*b*⁴ ♂ *00 p* – – – (alb.)	... ...	... ...
	*b*⁵ ♀ *100xq*58.58.55(6*e*)	*b*⁶ ♀ *100xq*58.58.55(6*e*)	*b*⁷ ♀ *100xq*57.57.55(6*e*)	*c*¹ ♂ *100xq*58.58.55(6*e*)	... ...	... ...
	*c*³ ♀ *100xq*58.58.55(6*e*)	*c*³ ♀ *100xp*23.15.18(6*f*)	*c*⁴ ♀ *100xp*17.17.15(6*f*)	*c*⁵ ♀ *00 p* – – – (alb. *w*)	... ...	... ...
	*c*⁶ ♂ *00 p* – – – (alb.)	... ...	... ...	... ...	... ...	... ...
3*H*46	*a*¹ ♂ *45 p*50. 1. 3(3*f*)	*a*² ♂ *55 p*26. 1. 3(3*f*)	*a*³ ♂ *100xp*26.26.23(6*f*)	*a*⁴ ♀ *85 p*26. 1. 1(4–5*f*)	2*H*301*a*⁴ ♂ *100xp* 26.22.18(4–5*f*)	2*H*306*a*¹ ♀ *100yp*26.23. 2(5*f*)
	*a*⁵ ♀ *100xp*50.26.22(6*f*)	*a*⁶ ♀ *15 p*26. 1. 1(1*f*)	*a*⁷ – *p* – – – –	*a*⁸ – *p* – – – –	... ...	... ...
	*a*⁹ – *p* – – – –	*b*¹ ♂ *100xp*23.23.17(6*f*)	*b*² ♂ *90 p*26.23. 2(4–5*f*)	*b*³ ♂ *80 p*26. 1. 1(4*f*)	... ...	... ...
	*b*⁴ ♀ *100xp*26.26.23(6*f*)	*b*⁵ – *p* – – – –	... ...	... ...	... ...	... ...
3*H*48	*a*¹ ♂ *85 p*41.41. 1(4*f*–*g*)	*a*² ♂ *100xq*58.58.55(6*e*)	*a*³ ♂ *100xq*58.58.55(6*e*)	*a*⁴ ♀ *100xq*58.58.55(6*e*)	2*H*303*a*¹ ♂ *100xq* 58.57.55(6*e*)	2*H*301*a*⁵ ♀ *100xq*58.57.55(6*e*)
	*a*⁵ ♀ – *q* – – – (6*e*)	... ...	... ...	... ...	... ...	... ...
3*H*49	*a*¹ ♂ *100xq*58.58.55(5*e*)	*a*² ♀ *90 q*58.60. 2(4*e*)	*a*³ ♀ *100xq*58.58.55(6*e*)	*a*⁴ – *p* – – – –	2*H*303*a*¹ ♂ *100xq* 58.57.55(6*e*)	2*H*301*a*⁶ ♀ *100xq*58.57.56(5–6*e*)
3*H*50	*a*¹ ♂ *100xp*22.12.17(5*f*)	*a*² ♂ *100yp*23.17. 1(5*f*)	*a*³ ♂ – *p* – – – (5*f*)	*a*⁴ ♀ *100xp*22.22.15(6*f*)	2*H*305*a*¹ ♂ *100xp* 26.23.23(6*f*)	2*H*305*a*³ ♀ *100xp*26.18.17(6*f*)
	*a*⁵ ♀ *100xp*26.26.22(5*f*)	*a*⁶ ♀ *100xp*23.22.17(6*f*)	*a*⁷ ♀ – *p* – – – (5*f*)	*a*⁸ – *p* – – – –	... ...	... ...
	*a*⁹ – *p* – – – –	*b*¹ ♂ *100xp*23.23.17(5*f*)	*b*² ♂ *95 p*23.17. 1(4–5*f*)	*b*³ ♀ *100xp*37.23.23(5*f*)	... ...	... ...
	*b*⁴ ♀ *100xp*26.23.23(6*f*)	*b*⁵ ♀ – *p* – – – (6*f*)	*b*⁶ – *p* – – – –	*b*⁷ – *p* – – – –	... ...	... ...
	*b*⁸ – *p* – – – –	*b*⁹ – *p* – – – –	*b*¹⁰ – *p* – – – –	*c*¹ ♂ *100xp*26.23.17(6*f*)	... ...	... ...
	*c*² ♂ *100xp*19.19. 9(6*b*)	*c*³ ♀ *100xp*26.21.22(5*f*)	*c*⁴ ♀ *100xp*25.25.17(6*f*)	*c*⁵ ♀ *100xp*19.19. 9(5*b*)	... ...	... ...
3*H*51	*a*¹ ♂ *100xp*19.19. 9(6*a*)	*a*² ♂ – *p* – – – (5*f*)	*a*³ ♂ *100xp*26.23.17(5*f*)	*a*⁴ ♂ *100xp*26.23.15(5*f*)	2*H*305*a*¹ ♂ *100xp* 26.23.23(6*f*)	2*H*305*a*⁴ ♀ *100xp*22.22.18(6*f*)
	*a*⁵ ♀ *100xp*37.19. 9(5*a*)	*a*⁶ ♀ *100xp*26.26.23(6*f*)	*a*⁷ – *p* – – – –	*a*⁸ – *p* – – – –	... ...	... ...
	*b*¹ ♂ *100xp*19.19. 9(6*a*–*b*)	*b*² ♂ *35 p*50. 1. 1(3*f*)	*b*³ ♀ *100xp*26.23.23(5*f*)	*b*⁴ ♀ *100xp*25.25.15(5*f*)	... ...	... ...
	*b*⁵ – *p* – – – –	*b*⁶ – *p* – – – –	*b*⁷ – *p* – – – –	*b*⁸ – *p* – – – –	... ...	... ...
	*b*⁹ – *p* – – – –	... ...	... ...	... ...	... ...	... ...
3*H*52	*a*¹ ♂ *45 p*37. 1. 1(3*b*)	*a*² ♀ *100xp*39.35. 3(5*b*)	*a*³ ♀ *100xp*39.35. 3(5*b*)	*a*⁴ ♀ *50 p*37. 1. 1(3*b*)	2*H*310*b*² ♂ *65 p* 39. 1. 3(4*b*)	2*H*309*b*¹ ♀ *100xp*39.35.30(5*b*)
	*b*¹ ♀ – *p* – – – (4*b*)	*b*² ♀ *75 p*39.39. 4(5*b*)	*b*³ ♂ *45 p*40.36. 3(3*b*)	*b*⁴ ♂ – *p* – – – (5*b*)	... ...	... ...
	*b*⁵ ♂ *80 p*26.23. 2(4*b*–*f*)	*b*⁶ ♂ *100xp*26.23.23(6*f*)	*c*¹ ♂ – *p* – – – (4*b*)	*c*² ♂ *45 p*39. 1. 2(2*b*)	... ...	... ...
	*c*³ ♀ *100xp*39.39.28(5*b*)	*c*⁴ ♀ *100xp* 39.35. 2(5*b*)	*c*⁵ ♀ *75 p*39.35. 2(4*b*)	*c*⁶ – *p* – – – –	... ...	... ...
	*c*⁷ – *p* – – – –	... ...	... ...	... ...	... ...	... ...
3*H*53	*a*¹ ♂ – *p* – – – (6*b*)	*a*² ♂ *100xp*39.39.29(5*b*)	*a*³ ♀ *100xp*39.35.31(6*b*)	*a*⁴ ♀ *100xp*35.35.30(6*b*)	2*H*308*a*² ♂ *100xp* 39.35. 9(5–6*b*)	2*H*307*a*² ♀ *100xp*39.35.30(5*b*)
	*a*⁵ ♀ *100xp*39.35.30(5*b*)	*b*¹ ♂ *100xp*39.35.30(6*b*)	*b*² ♂ *100xp* 35.35.28(6*b*)	*b*³ ♂ *100xp* 35.35.30(6*b*)	... ...	... ...
	*b*⁴ ♂ *100xp*35.35.28(5*b*)	*b*⁵ ♀ *100xp*39.39. 9(5*b*)	*b*⁶ ♀ *100xp*39.35.31(6*b*)	*b*⁷ – *p* – – – –	... ...	... ...
	*b*⁸ – *p* – – – –	*c*¹ ♂ *100xp*39.35. 3(5*b*)	*c*² ♂ *80 p*36.34. 4(5*b*)	*c*³ ♀ *100xp*39.35.28(6*b*)	... ...	... ...
	*c*⁴ ♀ *100xp*39.35.34(6*b*)	*c*⁵ ♀ *100xp*39.35.30(5*b*)	*c*⁶ ♀ *100xp*36.36. 4(5*b*)	*c*⁷ – *p* – – – –	... ...	... ...
3*H*54	*a*¹ ♂ *100xp*23.17.17(6*f*)	*a*² ♂ *100xp*39.39.30(6*bw*)	*a*³ ♀ *35 p*37. 1. 3(2–3*b*)	*a*⁴ ♀ *100xp*35.35.30(6*bw*)	3*H*308*a*¹ ♂ *100xp* 35.35.30(5*b*)	2*H*307*a*³ ♀ *100xp*39.39.36(5*b*)
	*b*¹ ♂ *100xp*37.19.19(5*b*)	*b*² ♂ *100xp*26.26.26(5*b*)	*b*³ ♂ *30 p*37. 1. 3(2*b*)	*b*⁴ ♀ *100xp*15.10.10(5*f*)	... ...	... ...
	*c*¹ ♂ *35 p*36. 1. 1(2*b*)	*c*² ♂ *35 p*37. 1. 1(2*b*)	*c*³ ♀ *100xp*35.35. 9(5*b*)	*c*⁴ ♀ *100yp*23.15.10(5*f*)	... ...	... ...
	*c*⁵ – *p* – – – –	... ...	... ...	... ...	... ...	... ...
3*H*57	*a*¹ ♂ *100xp*39.35.28(5*b*)	*a*² ♂ *25 p*39. 1. 1(2*b*)	*a*³ ♀ *20 p*39. 1. 1(2*b*)	*a*⁴ ♀ *55 p*39. 1. 1(3–4*b*)	2*H*309*a*² ♂ – *p* – – – (5*b*)	2*H*308*a*³ ♀ *100xp*39.35. 9(5*b*)
	*a*⁵ ♀ *80 p*39.39. 4(5*b*)	... ...	... ...	... ...	... ...	... ...
3*H*59	*a*¹ ♂ *100xq*41.41.50(6*e*–*g*)	*a*² ♀ *80 r* 41. 1. 1(4*gw*)	*a*³ ♀ *60 r*?41.37. 1(4*g*)	*a*⁴ ♀ *45 r* 41. 1. 2(3–4*g*)	3*H*1*c*⁴ ♂ *100xr* or *q* 41.41.50(6*g*)	2*H*314*c*² ♀ *70 q*42.50. 1(3*g*)
	*a*⁵ ♀ *55 p*36. 9. 3(4*bw*)	*a*³ – *p* – – – –	*a*⁷ – *p* – – – –	*b*¹ ♂ *90 r* 41.41. 1(4*g*)	... ...	... ...
	*b*² ♀ *100xr* 41.41.50(6*g*)	*b*³ ♀ *100xr* 41.41.50(5*g*)	*b*⁴ ♀ *85 r* 41.50. 1(4*g*)	*b*⁵ ♀ *100xp*19. 6. 6(6*b*)	... ...	... ...

	b^6 – *p* – – – –	b^7 – *q* – – – –	c^1 ♂ *100xr* 41.41.50(5*g*)	c^2 ♂ – *r* – – –(3*g*)	... ...	... ...	
	c^3 ♂ *85 p*37.34. 3(5*b*)	c^4 ♀ *80 r* 41.50. 1(4*g*)	c^5 ♀ *100xr* 41.41.50(5–6*g*)	c^6 ♀ *60 p*19. 9. 1(4*b*)	... ...	... ...	
*H*60	a^1 ♂ *50 p*23.23. 1(3*f*)	a^2 ♂ *60 p*26. 1. 1(4*f*)	a^3 ♂ *65 p*23.15. 1(4*f*)	a^4 ♀ *100xp*22.18.18(6*f*)	2*H*302b^1 ♂ *100xp* 23.15.15(6*f*)	2*H*305b^3 ♀ *100yp*23.23.17(6*f*)	
3*H*61	a^1 ♂ *100xp*23.17.18(6*f*)	a^2 ♀ *100xp*23.23.15(5*f*)	a^3 ♀ *100yp*23.15.10(5*f*)	a^4 ♀ *50 p*26. 1. 1(3*f*)	2*H*303b^1 ♂ – *p* – – –(6*f*)	2*H*305b^4 ♀ *30 p*26. 1. 1(2*f*)	
	a^5 ♀ *40 p*50. 1. 1(3*f*)	a^6 ♀ – *p* – – –(3*f*)	a^7 – *p* – – – –	a^8 – *p* – – – –	... ...	... ...	
	a^9 – *p* – – – –	a^{10} – *p* – – – –	a^{11} – *p* – – – –	b^1 ♂ *50 p*26. 1. 3(3*f*)	... ...	... ...	
	b^2 ♀ *55 p*26. 1. 2(3*f*)	b^3 ♀ *60 p*26. 1. 3(3*f*)	b^4 ♀ *55 p*50. 1. 1(3*f*)	b^5 ♀ *100xp*26.26.23(6*f*)	... ...	... ...	
	b^6 – *p* – – – –	... ...	... ...	... ...	... ...	... ...	
3*H*64	a^1 ♂ *100xp*15.15.18(6*f*)	a^2 ♂ – *p* – – –(5*f*)	a^3 ♂ – *p* – – –(6*f*)	a^4 ♂ *100xp*19.19.18(6*f*)	2*H*306b^3 ♂ *100xp* 23.23.18(5*f*)	2*H*312b^4 ♀ *100xp*15.15.10(6*f*)	
	a^5 – *p* – – – –	a^6 – *p* – – – –	b^1 ♂ – *p* – – –(6*f*)	b^2 ♂ *100xp*22.17.15(6*f*)	... ...	... ...	
	b^3 ♀ *100xp*23.15.10(6*f*)	b^4 ♀ *100xp*22.17.15(6*f*)	b^5 – *p* – – – –	b^6 – *p* – – – –	... ...	... ...	
	b^7 – *p* – – – –	c^1 ♂ – *p* – – –(5*f*)	c^2 ♂ *100xp*23.15.18(6*f*)	c^3 ♀ *100xp*23.23.17(6*f*)	... ...	... ...	
	c^4 ♀ *100xp*13.10.10(6*f*)	c^5 – *p* – – – –	c^6 – *p* – – – –	... ...	... ...	... ...	
3*H*65	a^1 ♂ *100xp*23.22.17(6*f*)	a^2 ♂ *100xp*22.22.18(5*f*)	a^3 ♂ *100yp*19. 6. 2(5*f*)	a^4 ♂ *95 p*22.18. 1(5*f*)	2*H*306b^2 ♂ *100xp* 23.23.15(5*f*)	2*H*305a^5 ♀ *100xp*23.23.18(6*f*)	
	a^5 ♀ *100yp*22.17.10(4–5*f*)	a^6 – *p* – – – –	a^7 – *p* – – – –	b^1 ♂ *100xp*22.18.18(5*f*)	... ...	... ...	
	b^2 ♂ *100xp*22.22.15(5*f*)	b^3 ♂ *100xp*23.17.17(5*f*)	c^1 ♂ *100yp*23.23.17(6*f*)	c^2 ♂ *100yp*26.23.17(5*f*)	... ...	... ...	
	c^3 ♂ *100yp*26.26. 2(5*f*)	c^4 ♂ *100yp*22.18.10(5*f*)	c^5 ♂ *100xp*23.17.15(5*f*)	... ...	... ...	... ...	
3*H*66	a^1 ♂ *55 p*26. 1. 1(3*f*)	a^2 ♂ – *p* – – –(2–3*f*)	a^3 ♂ – *p* – – –(2*f*)	a^4 ♂ – *p* – – –(2*f*)	2*H*306b^4 ♂ *25 p* 26. 1. 2(2–3*f*)	2*H*305a^6 ♀ *25 p*23. 1. 1(2*f*)	
	a^5 ♂ *15 p*23. 1. 2(1*f*)	a^6 ♀ *15 p*23. 1. 1(1–2*f*)	a^7 ♀ *30 p*25. 1. 2(2*f*)	b^1 ♂ – *p* – – –(2*f*)	... ...	... ...	
	b^2 ♂ *30 p*26. 1. 1(2–3*f*)	b^3 ♀ *25 p*23. 1. 1(2*f*)	b^4 ♀ *25 p*26. 1. 1(2*f*)	b^5 ♀ *55 p*26.26. 3(3*f*)	... ...	... ...	
	b^6 ♀ *20 p*26. 1. 2(1*f*)	b^7 ♀ *25 p*26. 1. 1(1–2*f*)	b^8 – *p* – – – –	b^9 – *p* – – – –	... ...	... ...	
	c^1 ♂ – *p* – – –(1*f*)	c^2 ♂ – *p* – – –(1*f*)	c^3 ♀ *10 p*23. 1. 1(1*f*)	c^4 ♀ *30 p*23. 1. 3(2*f*)	... ...	... ...	
	c^5 ♀ *25 p*23. 1. 1(2*f*)	c^6 ♀ *25 p*26. 1. 2(2*f*)	c^7 – *p* – – – –	c^8 – *p* – – – –	... ...	... ...	
	c^9 – *p* – – – –	c^{10} – *p* – – – –	c^{11} – *p* – – – –	... ...	... ...	... ...	
3*H*67	a^1 ♂ *100xq*58.58.55(6*e*)	a^2 ♂ – *q* – – –(6*e*)	a^3 ♀ *00 p* – – –(alb.)	a^4 ♀ *100xq*58.58.55(6*e*)	2*H*312c^2 ♂ *100xq* 58.58.55(6*e*)	2*H*302b^5 ♀ *100xq*58.58.55(6*e*)	
	a^5 ♀ *100xq*58.58.56(6*e*)	b^1 ♂ *00 p* – – –(alb.)	b^2 ♂ *100xp*23.23.17(6*f*)	b^3 ♂ *100xq*58.58.55(6*e*)	... ...	... ...	
	b^4 ♂ *100xq*58.58.55(6*e*)	b^5 ♀ *100xp*23.23.23(6*f*)	b^6 – *q* – – – –	b^7 – *q* – – – –	... ...	... ...	
	c^1 ♂ *100xq*58.58.55(6*e*)	c^2 ♂ *90 q*61.52. 6(4*e*)	c^3 ♀ *100xq*58.58.55(6*e*)	c^4 ♀ *100xp*24.24.15(6*f*)	... ...	... ...	
	c^5 – *p* – – – –	... ...	... ...	... ...	... ...	... ...	
3*H*69	a^1 ♂ *00 p* – – –(alb.)	a^2 ♂ *100xp*23.23.17(6*f*)	a^3 ♂ *100xq*58.58.57(6*e*)	a^4 ♂ *100xq*58.58.57(6*e*)	2*H*312b^3 ♂ *100xq* 58.57.55(6*e*)	2*H*300b^3 ♀ *100xq*58.56.56(6*e*)	
	a^6 – *q* – – – –	b^1 ♂ *100xq*58.58.55(6*e*)	b^2 ♀ *100xq*58.58.57(6*e*)	b^3 ♀ *00 p* – – –(alb.)	... ...	... ...	
	b^4 – *p* – – – –	b^5 – *p* – – – –	b^6 – *q* – – – –	b^7 – *q* – – – –	... ...	... ...	
	c^1 ♂ *00 p* – – –(alb.)	c^2 ♂ *00 p* – – –(alb.)	c^3 ♂ *00 p* – – –(alb.)	c^4 ♀ *100xq*58.58.55(6*e*)	... ...	... ...	
	c^5 – *q* – – – –	c^6 – *q* – – – –	c^7 – *q* – – – –	... ...	... ...	... ...	
3*H*70	a^1 ♀ *85 q*58.58. 2(4*e*)	a^2 ♀ *100xq*58.58.55(6*e*)	a^3 ♂ *100xq*58.58.55(6*e*)	a^4 ♂ *100xq*58.58.55(6*e*)	2*H*303b^4 ♂ *100xq* 58.58.55(5*e*)	2*H*300c^3 ♀ *100xq*58.56.56(6*e*)	
	a^5 – *q* – – – –	a^6 – *p* – – – –	b^1 ♂ *100xp*15.15.18(6*f*)	b^2 ♂ *100xq*57.57.55(5*e*)	... ...	... ...	
	b^3 ♀ *65 q*58.58. 1(4*e*)	b^4 ♀ *100xq*58.58.55(6*e*)	b^5 – *p* – – – –	b^6 – *q* – – – –	... ...	... ...	
	c^1 ♂ *65 q*58. 1. 1(3*e*)	c^2 ♀ *100xq*58.58.56(6*e*)	c^3 ♀ *100xq*58.58.55(6*e*)	c^4 ♀ *100xq*58.58.55(6*e*)	... ...	... ...	
	c^5 – *q* – – – –	c^6 – *q* – – – –	... ...	... ...	... ...	... ...	
3*H*71	a^1 ♂ *100xq*58.58.55(6*e*)	a^2 ♂ *100xq*58.58.55(6*e*)	a^3 ♂ – *q* – – –(6*e*)	a^4 ♂ – *q* – – –(6*e*)	2*H*303b^5 ♂ *100xq* 58.57.55(6*e*)	2*H*300c^4 ♀ *100xq*57.56.55(6*e*)	
	a^5 ♀ – *q* – – –(5*e*)	a^6 – *q* – – – –	a^7 – *q* – – – –	b^1 ♂ *100xq*58.57.55(6*e*)	... ...	... ...	
	b^2 ♂ *100xq*58.58.55(6*e*)	c^1 ♂ *100xq*58.57.55(6*e*)	c^2 ♂ *100xq*58.58.55(6*e*)	c^3 ♂ *100xq*57.57.52(5*e*)	... ...	... ...	
	c^4 ♀ *100xq*58.58.55(6*e*)	c^5 – *q* – – – –	c^6 – *q* – – – –	... ...	... ...	... ...	
4*H*1	a^1 ♂ *100xq*58.57.55(6*e*)	a^2 ♂ *100xq*58.57.55(6*e*)	a^3 ♂ *100xq*58.57.55(6*e*)	a^4 ♀ *45 q*58. 1. 1(3*e*)	3*H*3a^4 ♂ *100xq* 58.58.55(6*e*)	3*H*1a^8 ♀ *100xq*58.57.55(6*e*)	
	a^5 ♀ *80 r*41. 1. 1(4*g*)	a^6 ♀ *100xr* 41.41.50(6*g*)	a^7 ♀ *100xr* 41.41.50(5*g*)	... ...	... ...	... ...	
4*H*2	a^1 ♂ *70 q*58.55. 2(4*e*)	a^2 ♂ *100xq*58.57.56(6*e*)	a^3 ♂ *100xq*58.57.56(6*e*)	a^4 ♂ *00 p* – – –(alb.)	3*H*9a^3 ♂ *100xq* 58.58.55(6*e*)	3*H*2a^7 ♀ *100xq*56.57.55(5–6*e*)	
	a^5 ♀ *00 p* – – –(alb.)	a^6 ♀ *90 q*57.55. 1(5*e*)	a^7 ♀ *100xq*58.58.57(6*e*)	b^1 ♂ *00 p* – – –(alb.)	... ...	... ...	

MATING	OFFSPRING				PARENTS	
					Father	Mother
4*H*2	b^2 ♂ *100xq*58.57.56(6*e*)	b^3 ♂ *100xq*58.57.55(6*e*)	b^4 ♂ *70 q*58.57. 2(3–4*e*)	b^5 ♂ *90 q*58.55. 2(4*e*)	... ...	... ...
	b^6 – *p* – – – –	b^7 – *p* – – – –	c^1 ♂ *100xq*58.57.55(6*e*)	c^2 ♂ *100xq*58.57.55(6*e*)	... ...	... ...
	c^3 ♂ *100xq*58.57.55(6*e*)	c^4 ♂ *85 q*58.55. 1(4*e*)	c^5 ♂ *00 p* – – –(alb.)	c^6 ♀ *100xq*58.57.56(6*e*)	... ...	... ...
	c^7 ♀ *60 q*58. 1. 2(4*e*)	c^8 ♀ *70 q*58.55. 2(4*e*)	... ...	... ...	... ...	... ...
4*H*3	a^1 ♂ *100xq*58.57.55(6*ew*)	a^2 ♂ – *q* – – –(6*e*)	a^3 ♀ *00 p* – – –(alb.)	a^4 ♀ *55 q*58. 1. 2(3*e*)	3*H*2a^4 ♂ *100xq*58.58.55(5–6*e*)	3*H*3a^3 ♀ *100xq*58.58.55(5–6*e*)
	a^5 ♀ *00 p* – – –(alb.)	a^6 – *p* – – – –	b^1 ♂ *100xq*58.58.55(6*e*)	b^2 ♂ *100xq*58.57.56(6*e*)	... ...	... ...
	b^3 ♂ *100xq*58.58.55(6*e*)	b^4 ♀ *70 q*58. 1. 2(4*e*)	b^5 ♀ *100xq*58.57.56(6*e*)	b^6 ♀ *100xq*58.57.56(6*e*)	... ...	... ...
	b^7 – *p* – – – –	c^1 ♂ – *q* – – –(6*ew*)	c^2 ♂ *100xq*57.57.56(6*e*)	c^3 ♂ *45 q*58. 1. 2(4*e*)	... ...	... ...
	c^4 ♂ *00 p* – – –(alb.*w*)	c^5 ♀ *60 q*58. 1. 4(4*ew*)	c^6 ♀ *100xq*58.58.55(6*e*)	c^7 ♀ *100xq*58.57.55(6*e*)	... ...	... ...
	c^8 – *p* – – – –	c^9 – *p* – – – –	c^{10} – *p* – – – –	... ...	... ...	... ...
4*H*4	a^1 ♂ *100xp*23.23.18(6*f*)	a^2 ♂ *100xq*57.57.56(5–6*e*)	a^3 ♀ *100xp*22.18. 2(4–5*f*)	a^4 ♀ *100xq*58.57.55(5*e*)	3*H*2a^3 ♂ *100xq*57.57.55(5*e*)	3*H*6a^4 ♀ *100yq*58.58.55(5*e*)
	a^5 – *q* – – – –	b^1 ♂ *100xq*58.57.55(5*e*)	b^2 ♂ *100xq*58.58.55(5*e*)	b^3 ♂ *100xq*58.57.55(6*e*)	... ...	... ...
	b^4 ♀ *100xq*58.57.55(6*e*)	b^5 ♀ *45 q*58. 1. 1(3*e*)	b^6 – *p* – – – –	b^7 – *p* – – – –	... ...	... ...
	c^1 ♂ *100xq*58.58.55(6*e*)	c^2 ♂ – *p* – – –(3*fw*)	c^3 ♂ – *p* – – –(6*f*)	c^4 ♀ *100yq*58.55. 1(5*e*)	... ...	... ...
	c^5 ♀ *85 q*58.55. 1(4*e*)	c^6 ♀ *35 q*58. 1. 1(3*e*)	c^7 ♀ *100yp*23.18. 4(5*f*)	c^8 – *q* – – – –	... ...	... ...
	c^9 – *q* – – – –	c^{10} – *q* – – – –	... ...	... ...	... ...	... ...
4*H*6	a^1 ♀ *00 p* – – –(alb.)	a^2 ♀ *95 q*58.57.55(5*e*)	b^1 ♂ *100yq*58.55. 2(5*e*)	b^2 ♂ *100yq*57.56.55(5*e*)	3*H*6a^2 ♂ *100yq*58.57. 2(5*e*)	3*H*7a^4 ♀ *100xq*58.58.55(6*e*)
	b^3 ♂ *100yq*58.57.56(5*e*)	b^4 ♀ *95 q*58.57. 2(5*e*)	b^5 ♀ *100yq*57.57.55(5*e*)	c^1 ♂ *100xq*58.57.55(5*e*)	... ...	... ...
	c^2 ♀ *100yq*57.57.56(5*e*)	c^3 ♀ *100yq*58.56. 2(5*e*)	c^4 ♀ *100xq*57.57.56(6*e*)	c^5 ♀ *100xq*58.57.57(6*e*)	... ...	... ...
4*H*7	a^1 ♂ *100xq*58.57.55(5*e*)	a^2 ♀ *100xq*58.57.56(5–6*e*)	... ...	... ...	3*H*6a^3 ♂ *100xq*57.57.56(5–6*e*)	3*H*7a^3 ♀ *100xq*58.58.55(6*e*)
4*H*8	a^1 ♀ *80 p*26.23. 1(4–5*f*)	a^2 ♂ *65 p*26.23. 1(4*f*)	a^3 ♀ *55 p*26.22. 1(3–4*f*)	a^4 ♂ *65 p*26.23. 2(3–4*f*)	3*H*3a^2 ♂ *60 p*23. 1. 1(3*f*)	3*H*1a^3 ♀ *55 p*26.26. 1(3*f*)
	a^5 ♂ *50 p*19. 9. 3(3*f*)	a^6 ♂ *90 p*26. 3. 3(5*f*)	a^7 ♂ *55 p*23.22. 2(3*f*)	a^8 – *p* – – – –	... ...	... ...
4*H*9	a^1 ♂ *95 p*26.22.18(4–5*f*)	a^2 ♂ – *p* – – –(4*f*)	a^3 ♂ *45 p*37. 1. 2(3*f*)	a^4 ♂ *00 p* – – –(alb.)	3*H*1a^1 ♂ *60 q*58.57. 1(3*e*)	3*H*2a^6 ♀ *75 q*55. 1. 1(4*e*)
	a^6 ♀ *55 p*37.37. 1(4*f*)	a^8 ♀ *60 p*37.37. 4(4*f*)	a^7 ♀ *30 q*58. 1. 1(3*e*)	a^8 ♀ *00 p* – – –(alb.)	... ...	... ...
	b^1 ♀ *70 p*26.23. 1(4*f*)	b^2 ♀ *60 p*26. 1. 2(4*f*)	c^1 ♂ *75 q*58. 1. 2(4*e*)	c^2 ♂ *45 q*58. 1. 1(3*e*)	... ...	... ...
	c^3 ♀ *80 p*26. 1. 2(4*f*)	c^4 ♀ *65 p*23. 1. 3(4*f*)	c^5 – *p* – – – –	... ...	... ...	... ...
4*H*10	a^1 ♂ *75 q*58.55. 2(4*e*)	a^2 ♂ *65 q*58. 1. 2(4*ew*)	a^3 ♂ *00 p* – – –(alb.)	a^4 ♀ *70 p*26.26. 1(4*f*)	3*H*2a^2 ♂ *85 q*58.55. 2(4*e*)	3*H*9a^5 ♀ – *q* – – –(4*e*)
	a^5 ♀ *00 p* – – –(alb.)	a^6 ♀ *90 q*58.55. 4(4–5*e*)	a^7 ♀ *55 q*58.57. 1(4*e*)	a^8 ♀ *55 q*58. 1. 2(3*ew*)	... ...	... ...
	a^9 – *q* – – – –	a^{10} – *q* – – – –	b^1 ♂ *90 p*26.18. 2(4*fw*)	b^2 ♂ *55 q*58. 1. 2(3*ew*)	... ...	... ...
	b^3 ♂ – *p* – – –(3*fw*)	b^4 ♀ *95 q*58.55. 2(5*e*)	b^5 ♀ *45 p*26. 1. 1(3*f*)	b^6 ♂ – *q* – – –(4*e*)	... ...	... ...
	b^7 ♂ *90 q*58.55. 2(4*e*)	b^8 ♂ *95 q*58.55. 2(4*e*)	... ...	... ...	... ...	... ...
4*H*11	a^1 ♀ *95 q*58.56. 2(4–5*e*)	a^2 ♀ *95 q*57.56. 1(4–5*e*)	a^3 ♀ *60 q*58. 1. 1(4*e*)	a^4 ♀ *80 q*57.56. 1(4*e*)	3*H*15a^6 ♂ *65 q*57.55. 3(4*e*)	3*H*13a^4 ♀ *60 q*58.58. 1(3–4*e*)
	a^5 ♂ – *q* – – – –	a^6 ♂ – *q* – – – –	a^7 – *q* – – – –	a^8 ♂ – *p* – – – –	... ...	... ...
	b^1 ♂ *00 p* – – –(alb.)	b^2 ♂ *60 q*58.57. 1(4*e*)	b^3 ♀ *75 q*58.57. 1(4*e*)	b^4 ♀ *60 q*58.57. 2(3–4*e*)	... ...	... ...
	b^5 – *q* – – – –	b^6 – *q* – – – –	b^7 – *q* – – – –	b^8 – *q* – – – –	... ...	... ...
4*H*12	a^1 ♂ *55 r*42.50. 2(4*g*)	a^2 ♂ *65 r*42.50. 1(4*g*)	a^3 ♂ *00 p* – – –(alb.)	a^4 – ? – – – ?	3*H*1a^2 ♂ *50 r*42.50. 1(3*g*)	3*H*13a^2 ♀ *80 r*41.50. 1(4*g*)
	a^5 ♀ *30 r*42.50. 2(3*g*)	a^6 ♀ *60 r*26.26. 2(4*g*)	b^1 ♂ *65 r*41.50. 2(3–4*g*)	b^2 ♂ *00 p* – – –(alb.)	... ...	... ...
	b^3 ♀ *95 r*41.50. 3(4–5*g*)	b^4 ♀ *45 r*41.41. 2(3*g*)	b^5 ♀ *00 p* – – –(alb.)	c^1 ♂ *70 r*41.50. 2(4*g*)	... ...	... ...
	c^2 ♀ *25 q*41. 1. 2(2*g*)	c^3 ♀ *85 r*41.26. 2(4*g*)	c^4 ♀ *60 r*50.50. 1(4*g*)	c^5 ♀ *55 r*41.50. 1(3–4*g*)	... ...	... ...
	c^6 ♀ *00 p* – – –(alb.)	c^7 – *q* – – – –	c^8 – *q* – – – –	... ...	... ...	... ...
4*H*13	a^1 ♂ *60 q*58.58. 3(4*e*)	a^2 ♂ *90 q*58.56. 2(4–5*e*)	a^3 ♂ *90 q*58.55. 2(4–5*e*)	a^4 ♂ – *q* – – –(3-4*ew*)	3*H*15a^4 ♂ *65 q*58. 1. 2(3*e*)	3*H*1a^6 ♀ *45 q*58.55. 1(3*e*)
	a^5 ♂ *40 q*58. 1. 2(3*e*)	a^6 ♀ *00 p* – – –(alb.)	a^7 ♀ *00 p* – – –(alb.)	b^1 ♂ *85 q*58.55. 1(4–5*e*)	... ...	... ...
	b^2 ♂ *80 q*58.57. 2(4*e*)	b^3 ♂ *60 q*58.55. 2(3–4*e*)	b^4 ♂ *50 q*58. 1. 1(3*e*)	b^5 ♂ *55 q*57.55. 2(3*ew*)	... ...	... ...
	b^6 ♀ *90 q*58.58. 4(5*e*)	b^7 ♀ *75 q*58. 1. 2(3–4*e*)	b^8 ♀ *00 p* – – –(alb.)	b^9 – *p* – – – –	... ...	... ...
	c^1 ♂ *00 p* – – –(alb.*w*)	c^2 ♂ *00 p* – – –(alb.)	c^3 ♂ *75 q*58.55. 2(4*e*)	c^4 ♂ *60 q*58. 1. 2(3–4*e*)	... ...	... ...

	c^5 ♀ *35 q58. 1. 2(3ew)*	c^6 ♀ *65 q58. 1. 3(3–4e)*	c^7 – *q – – – –*	c^8 – *q – – – –*	… … … …	… … … …	
4*H*14	a^1 ♀ *75 p35.35. 2(5b)*	a^2 ♀ *75 p35.35. 2(5b)*	a^3 ♀ *75 p35.35. 2(5b)*	a^4 ♂ *75 p35.35. 3(5b)*	3*H*20a^1 ♂ *75 p36.35. 4(5b)*	3*H*21a^3 ♀ *75 p39.39. 4(5b)*	
	a^5 ♂ *75 p39.35.28(5b)*	a^6 ♂ *75 p35.35. 2(5b)*	a^7 – *p – – – –*	b^1 ♂ *75 p39.39.28(5b)*	… … … …	… … … …	
	b^2 ♂ *100zp39.35.28(5b)*	b^3 ♀ *75 p39.39.28(5b)*	b^4 ♀ *75 p39.39.28(5b)*	b^5 ♀ *80 p39.39. 2(5a)*	… … … …	… … … …	
	b^6 – *p – – – –*	b^7 – *p – – – –*	c^1 ♂ *75 p36.35. 4(5b)*	c^2 ♂ *75 p39.39. 2(5b)*	… … … …	… … … …	
	c^3 ♂ *75 p39.39. 4(4–5b)*	c^4 ♂ *100zp39.39.29(5b)*	c^5 ♀ *100zp35.33.28(5b)*	c^6 ♀ *100zp35.35.28(5b)*	… … … …	… … … …	
	c^7 – *p – – – –*	… … … …	… … … …	… … … …	… … … …	… … … …	
4*H*15	a^1 ♂ *75 p36.23. 2(5a–b)*	a^2 ♂ *100xp23.23.18(6f)*	a^3 ♂ *100xp10.10.10(6f)*	a^4 ♂ *100zp15.15. 5(6f)*	3*H*20a^1 ♂ *75 p36.35. 4(5b)*	3*H*21a^4 ♀ *80 p39.39. 4(5b)*	
	a^5 ♀ *75 p36.36. 2(5b)*	b^1 ♂ *100zp39.35.28(5a–f)*	b^2 ♂ – *p – – –(5b)*	b^3 ♀ – *p – – –(6f)*	… … … …	… … … …	
	b^4 ♀ *100zp35.35.28(5b)*	b^5 ♀ – *p – – –(5b)*	b^6 – *p – – – –*	b^7 – *p – – – –*	… … … …	… … … …	
	b^8 – *p – – – –*	… … … …	… … … …	… … … …	… … … …	… … … …	
4*H*16	a^1 ♀ *80 p39.39. 4(4–5b)*	a^2 ♀ – *p – – –(5b)*	a^3 ♀ *100zp39.39.28(5b)*	a^4 ♀ *80 p39.39.28(5b)*	3*H*20a^2 ♂ *80 p36.36. 4(5b)*	3*H*21a^5 ♀ *100zp39.39.28(5b)*	
	a^5 ♂ *100zp35.35.28(5b)*	a^6 ♂ *100zp39.35.28(5b)*	a^7 ♂ *80 p35.35. 2(5b)*	a^8 ♂ *75 p39.35. 2(5b)*	… … … …	… … … …	
	b^1 ♂ *100zp39.39.30(5b)*	b^2 ♂ *100zp39.39.28(4-5a–b)*	b^3 ♂ *100zp39.39.28(5b)*	b^4 ♂ *75 p39.35. 2(5b)*	… … … …	… … … …	
	b^5 ♂ *100zp39.35.30(5a)*	b^6 ♂ *60 p26.26. 1(3b)*	b^7 – *p – – – –*	b^8 – *p – – – –*	… … … …	… … … …	
	c^1 ♂ *100zp39.35.29(5b)*	c^2 ♀ *100zp40.40.31(5b)*	c^3 ♀ *75 p39.39. 4(5b)*	c^4 ♀ *75 p39.39.28(4–5b)*	… … … …	… … … …	
	c^6 ♀ *65 p39.39. 2(4b)*	… … … …	… … … …	… … … …	… … … …	… … … …	
4*H*17	a^1 ♂ *100xp23.23.18(6f)*	a^2 ♂ *100xp26.26.17(6f)*	a^3 ♀ *100xp23.23.18(6f)*	a^4 ♀ *100zp39.39.30(5a–b)*	3*H*20a^2 ♂ *80 p36.36. 4(5b)*	3*H*21a^6 ♀ *100zp39.39.30(5–6b)*	
	a^5 ♀ *75 p39.39.28(5b)*	a^6 ♀ *80 p35.35.28(5a)*	b^1 ♂ *100yp23.23.18(6f)*	b^2 ♂ – *p – – –(5a)*	… … … …	… … … …	
	b^3 ♂ – *p – – –(5b)*	b^4 ♀ *100xp23.23.18(6f)*	b^5 ♀ *100xp23.23.23(6f)*	b^6 ♀ *75 p35.35.28(5a)*	… … … …	… … … …	
	b^7 ♀ *45 p39.39. 2(3b)*	… … … …	… … … …	… … … …	… … … …	… … … …	
4*H*19	a^1 ♂ *30 p39. 1. 2(2–3b)*	a^2 ♂ *55 p39. 1. 4(3b)*	a^3 ♂ *40 p26. 1. 4(3f)*	a^4 ♀ *45 p39. 1. 3(3b)*	3*H*30a^2 ♂ *40 p40. 1. 2(2b)*	3*H*29a^4 ♀ *40 p37.39. 3(2–3b)*	
	a^5 ♀ *30 p23. 1. 2(2–3f)*	b^1 ♂ *25 p39. 1. 2(2b)*	b^2 ♂ *20 p37. 1. 1(2b)*	b^3 ♂ *25 p39. 1. 2(2b)*	… … … …	… … … …	
	b^4 ♂ *30 p37. 1. 1(3b)*	b^5 ♂ *40 p37. 1. 2(3b)*	b^6 ♂ *30 p39. 1. 3(3b)*	b^7 ♀ *45 p39. 1. 3(3b)*	… … … …	… … … …	
	c^1 ♀ *65 p39. 1. 2(4b)*	… … … …	… … … …	… … … …	… … … …	… … … …	
4*H*20	a^1 ♀ *100zp36.36.30(6b)*	a^2 ♀ *100xp35.35.30(6b)*	a^3 ♀ *100zp39.39.28(5b)*	a^1 ♀ *100xp23.23.15(6f)*	3*H*21a^1 ♂ *80 p39.35. 2(5b)*	3*H*20a^3 ♀ – *p – – –(5b)*	
	a^5 ♀ *100zp10.23.15(6f)*	b^1 ♂ *100xp23.23.17(6f)*	b^2 ♂ *100zp39.39.28(5b)*	b^3 ♀ *100zp39.35.30(5–6b)*	… … … …	… … … …	
	b^4 ♀ *100zp35.35.28(5b)*	b^5 ♀ *100zp39.35.31(6b)*	b^6 ♀ *100xp39.35.31(6b)*	… … … …	… … … …	… … … …	
4*H*21	a^1 ♂ *75 p35.35.28(5b)*	a^2 ♂ *100zp39.35.34(6b)*	a^3 ♂ – *p – – –(5b)*	a^4 ♂ – *p – – –(5b)*	3*H*21a^1 ♂ *80 p39.35. 2(5b)*	3*H*20a^4 ♀ *100zp39.35.28(5b)*	
	a^5 ♀ *100zp39.39.36(6b)*	a^6 ♀ *75 p40.35. 2(5b)*	… … … …	… … … …	… … … …	… … … …	
4*H*22	a^1 ♂ *80 p39.39. 2(5b)*	a^2 ♂ *85 p35.35. 2(5b)*	a^3 ♂ *85 p35.35.28(5b)*	a^4 ♂ *100zp35.35.30(5b)*	3*H*21a^2 ♂ *80 p39.35. 2(5b)*	3*H*20a^5 ♀ *100zp35.35.28(6b)*	
	a^5 ♀ *80 p35.35. 3(5b)*	a^6 ♀ *100xp23.23.18(6f)*	b^1 ♂ *85 p39.35.28(5b)*	b^2 ♂ *80 p35.35.28(5b)*	… … … …	… … … …	
	b^3 ♀ *75 p39.39. 3(5b)*	b^4 ♀ *80 p35.35.28(5b)*	b^5 ♀ *100zp39.39.28(5b)*	b^6 ♀ *75 p35.35. 2(5b)*	… … … …	… … … …	
	b^7 ♀ *100zp39.39.28(5b)*	c^1 ♂ *75 p39.35. 2(5b)*	c^2 ♂ *100xp15.15.10(6f)*	c^3 ♂ *100xp15.15.10(6f)*	… … … …	… … … …	
	c^4 ♀ *80 p35.35. 2(5b)*	c^5 ♀ *80 p35.35. 2(5b)*	c^6 – *p – – – –*	… … … …	… … … …	… … … …	
4*H*23	a^1 – *q – – – –*	a^2 – *p – – – –*	b^1 ♂ *100xp37.19.31(6a–f)*	b^2 ♂ *100xp37.19.9(5-6a-f)*	3*H*5a^1 ♂ *100xq41.41.50(6g)*	3*H*8a^2 ♀ *35 r41.41. 3(2–3g)*	
	b^3 ♂ *100xp37.19.31(6a–f)*	b^4 ♀ *00 p – – –(alb.)*	b^5 ♀ *00 p – – –(alb.)*	b^6 ♀ *100xp19.19.31(6a–f)*	… … … …	… … … …	
	c^1 ♂ *100xr 41.41.50(5–6g)*	c^2 ♂ *100xr 41.41.26(5–6g)*	c^3 ♂ *100xp19.19. 9(5b)*	c^4 ♂ *00 p – – –(alb.)*	… … … …	… … … …	
	c^5 ♀ *00 p – – –(alb.)*	c^6 ♀ *100xq58.58.44(6e)*	c^7 ♀ *00 p – – –(alb.)*	… … … …	… … … …	… … … …	
4*H*24	a^1 ♂ *100xq58.57.55(5–6e)*	a^2 ♀ – *q – – –(5–6e)*	a^3 ♀ *100xq58.58.55(6e)*	a^4 ♀ *00 p – – –(alb.)*	3*H*5a^3 ♂ *100xq57.57.55(6e)*	3*H*8a^3 ♀ *100xq57.58.55(5e)*	
	a^5 – *p – – – –*	a^6 – *q – – – –*	a^7 – *q – – – –*	b^1 ♂ *100yq57.57.55(5e)*	… … … …	… … … …	
	b^2 ♂ *100xq58.57.55(5e)*	b^3 ♂ *00 p – – –(alb.)*	b^4 ♀ *100xq58.57.57(6e)*	b^5 ♀ *100yq57.57.55(5e)*	… … … …	… … … …	
	b^6 – *q – – – –*	b^7 – *q – – – –*	b^8 – *q – – – –*	b^9 – *q – – – –*	… … … …	… … … …	
	c^1 ♀ *100yq58.58.55(5e)*	c^2 ♀ *00 p – – –(alb.)*	c^3 – *p – – – –*	c^4 – *q – – – –*	… … … …	… … … …	
4*H*25	x – *p – – – –*	a^1 ♂ *100xq57.57.56(6e)*	a^2 ♀ *100xq58.58.55(6e)*	b^1 ♂ *100xq58.58.55(6e)*	3*H*5a^4 ♂ *100xq58.58.55(6e)*	3*H*4a^5 ♀ *100xq57.57.56(6e)*	
	b^2 ♂ *100xq58.57.55(6e)*	b^3 ♀ *100xq58.58.55(6e)*	b^4 ♀ *100xq58.57.55(6e)*	b^5 – *p – – – –*	… … … …	… … … …	
	c^1 ♂ *100xq57.57.56(6e)*	c^2 ♂ *100xp23.23.18(6f)*	c^3 ♀ *100xq58.57.55(6e)*	… … … …	… … … …	… … … …	
4*H*26	a^1 ♂ – *q – – –(6e)*	a^2 ♂ – *q – – –(6e)*	a^3 ♂ *85 q58.55. 2(4–5e)*	a^4 ♀ *100xp26.23.23(6a–f)*	3*H*5a^2 ♂ *100xq58.58.55(6e)*	3*H*4a^6 ♀ *100xq58.57.55(6e)*	
	a^5 ♀ *100xq58.58.56(6e)*	b^1 ♂ *100xq58.58.55(6e)*	b^2 ♂ *100xp22.22.18(6f)*	b^3 ♂ *100xp23.23.18(6f)*	… … … …	… … … …	
	b^4 – *q – – – –*	c^1 ♂ *100xq58.57.55(6e)*	c^2 ♂ *100xq58.57.55(6e)*	c^3 ♂ *75 p26.19. 2(4f)*	… … … …	… … … …	

MATING	OFFSPRING				PARENTS	
					Father	Mother
4*H*26	c^4 ♀ *100xq* 58.57.55(5*e*)	... ...	... ...	... ...	... ...	... ...
4*H*27	a^1 ♂ *100xp*23.23.18(6*f*)	a^2 ♂ *100xp*23.23.18(6*f*)	a^3 ♀ – *p* – – –(4*f*)	a^4 ♀ *100xp*23.23.18(5*f*)	? ♂ – *p* – – –(6*f*)	3*H*4a^3 ♀ *100xp*23.22.18(6*f*)
	a^5 ♀ *100xp*19.19. 9(6*a*)	a^6 ♀ *100xp*23.23.17(6*f*)	a^7 ♀ *100xp*19.19. 9(6*a*)	a^8 – *p* – – –	... ...	... ...
	b^1 ♂ *100xp*26.23.17(6*f*)	b^2 ♀ *100xp*19.19. 6(6*a*)	b^3 ♀ *100xp*19.19. 6(6*a*–*f*)	b^4 ♀ *100xp* 23.23.15(6*f*)	... ...	... ...
	b^5 ♀ *90 p*37.19. 1(4*a*)	b^6 ♀ *45 p*26.26. 3(3–4*f*)	b^7 – *p* – – –	b^8 – *p* – – –	... ...	... ...
	b^9 – *p* – – –	b^{10} – *p* – – –	c^1 ♂ *100xp*23.23.15(6*f*)	c^2 ♂ *100xp*26.23.18(6*f*)	... ...	... ...
	c^3 ♂ *100xp*23.23.17(6*f*)	c^4 ♀ *100xp*23.23.18(6*f*)	c^5 ♀ *100xp* 26.23.18(6*f*)	c^6 ♀ *70 p*26.23. 2(4*f*)	... ...	... ...
	c^7 – *p* – – –	... ...	... ...	... ...	... ...	... ...
4*H*28	a^1 ♂ *100xp*23.23.17(5*f*)	a^2 ♂ *100xp*19.19. 9(5*a*–*f*)	a^3 ♀ *90 p*26.26. 2(4*a*–*f*)	a^4 ♀ *100xp*19.19.31(6*a*–*f*)	? ♂ – *p* – – –(6*f*)	3*H*4a^4 ♀ *100xp*23.23.17(6*f*)
	a^5 ♀ *90 p*19.19. 1(5*a*–*f*)	a^6 ♀ *50 p*23. 1. 2(3*f*)	b^1 ♂ *100xp*26.23.18(6*f*)	b^2 ♂ *100xp*26.23.17(6*f*)	... ...	... ...
	b^3 ♂ *100xp* 19.19. 9(6*b*)	b^4 ♀ *100xp*19. 9. 9(6*b*)	b^5 ♀ *100xp*23.23.17(6*f*)	b^6 ♀ *100xp* 19.19. 9(5*b*)	... ...	... ...
	b^7 ♀ *50 p*23. 1. 2(3*f*)	c^1 ♂ *100yp*26.23. 2(4–5*f*)	c^2 ♂ *100xp*19.19. 9(6*a*)	c^3 ♂ *100xp*26.23.17(6*f*)	... ...	... ...
	c^4 ♂ *100xp*15.15.17(6*f*)	c^5 ♀ *65 p*26. 1. 2(4*f*)	c^6 ♀ *100xp*19.19. 9(6*a*)	c^7 ♀ *100xp*23.23.15(6*f*)	... ...	... ...
	c^8 ♀ *100xp*23.23.17(6*f*)	c^9 – *p* – – –	... ...	... ...	... ...	... ...
4*H*29	a^1 ♂ *90 p*19.23. 2(4*f*)	a^2 ♂ *75 p*26.23. 2(4*f*)	a^3 ♂ *65 p*23.23. 2(4*f*)	a^4 ♂ *65 p*26. 9. 1(4*f*)	3*H*42a^3 ♂ *55 p*23.23. 1(2–3*f*)	3*H*40a^1 ♀ *70 p*50.50. 1(4*f*)
	a^5 ♀ *75 p*15.15. 2(4*f*)	a^6 ♀ *65 p*50. 1. 2(4*f*)	a^7 ♀ *65 p*23.23. 1(4*f*)	... ...	... ...	... ...
4*H*30	a^1 ♂ *100xq*58.57.55(6*e*)	a^2 ♂ *100xq*58.57.55(6*e*)	a^3 ♂ *100xq*58.57.55(6*e*)	a^4 ♀ *100xq*58.57.55(6*e*)	3*H*1b^4 ♂ *100xq*58.58.56(6*e*)	3*H*3a^5 ♀ *100xq*56.56.55(6*e*)
	a^5 ♀ *100xq*58.57.55(6*e*)	a^6 ♀ *100xq*58.57.56(6*e*)	a^7 – *q* – – –(6*e*)	a^8 – *q* – – –(6*e*)	... ...	... ...
4*H*31	a^1 ♂ *100xq*58.58.55(6*e*)	a^2 ♂ *100xq*58.58.55(6*e*)	a^3 ♀ *100xq*58.58.55(6*ew*)	a^4 ♀ *100xq*58.58.57(6*ew*)	3*H*1b^3 ♂ *100xq*57.57.56(5–6*e*)	3*H*3b^9 ♀ *100xq*58.58.55(6*e*)
	a^5 ♀ *100xq*58.58.55(6*e*)	a^6 – *p* – – –	a^7 – *p* – – –	b^1 ♂ *100xq*57.57.55(6*ew*)	... ...	... ...
	b^2 ♂ *100xq*41.41.26(6*gw*)	b^3 ♂ *100xq*?41.41.26(6*g*)	b^4 ♂ *100xp*23.23.18(6*f*)	b^5 ♀ *100xp*23.23.18(6*f*)	... ...	... ...
	c^1 ♂ *100xq*58.58.55(6*ew*)	c^2 ♀ *100xp*19.19. 9(6*b*)	c^3 ♀ *100xp*23.23. 8(6*f*)	c^4 ♀ *100xq* 58.58.55(6*e*)	... ...	... ...
	c^5 ♀ *100xr* 40.40.50(6*g*)	... ...	... ...	... ...	... ...	... ...
4*H*33	a^1 ♂ *00 p* – – –(alb.)	a^2 ♂ *100xq*58.58.55(6*e*)	a^3 ♀ *100xp*15.15.15(6*f*)	a^4 ♀ *100xp*15.15.18(6*f*)	3*H*3b^5 ♂ *100xq*58.57.55(6*e*)	3*H*11a^5 ♀ *100xq*57.57.56(5–6*e*)
	b^1 ♀ *100xq*58.58.55(6*ew*)	b^2 ♂ *00 p* – – –(alb. *w*)	c^1 ♂ – *q* – – –(6*e*)	c^2 ♂ – *q* – – –(6*e*)	... ...	... ...
	c^3 ♂ *00 p* – – –(alb.)	c^4 ♀ *100xq*58.58.55(5*e*)	c^5 ♀ *00 p* – – –(alb.)	c^6 – *q* – – –	... ...	... ...
	c^7 – *q* – – –	c^8 – *p* – – –	c^9 – *p* – – –	... ...	... ...	... ...
4*H*36	a^1 ♂ *100xq*58.57.55(6*e*)	a^2 ♂ *00 p* – – –(alb.)	a^3 ♂ *00 p* – – –(alb.)	a^4 ♀ – *p* – – –(6*f*)	3*H*4b^3 ♂ *100xq*58.58.55(6*e*)	3*H*6b^2 ♀ *100xq*58.58.55(5–6*e*)
	a^5 – *q* – – –	b^1 ♂ – *q* – – –(6*e*)	b^2 ♂ *100xq*58.58.55(6*e*)	b^3 ♂ *00 p* – – –(alb.)	... ...	... ...
	b^4 ♀ – *q* – – –(6*e*)	b^5 ♀ *100xq*58.58.55(6*e*)	b^6 – *q* – – –	b^7 – *p* – – –	... ...	... ...
4*H*37	a^1 ♂ *100xq*58.58.55(6*e*)	a^2 ♂ – *p* – – –(6*f*)	a^3 ♀ *100xq*58.57.56(6*e*)	a^4 ♀ *100xp*26.26.17(6*f*)	3*H*4b^2 ♂ *100xq*58.58.55(6*e*)	3*H*6b^3 ♀ *100xq*56.57.55(5–6*e*)
	a^6 ♀ *100xq*58.58.55(6*e*)	b^1 ♂ – *q* – – –(6*e*)	b^2 ♂ *100xq*58.57.56(6*e*)	b^3 ♂ *100xq*58.58.56(6*e*)	... ...	... ...
	b^4 ♀ *100xq*58.58.55(6*e*)	b^5 ♀ *100xq*58.58.55(6*e*)	b^6 ♀ *100xq*57.57.56(6*e*)	c^1 ♂ *00 p* – – –(alb.)	... ...	... ...
	c^2 ♂ *00 p* – – –(alb.)	c^3 ♂ *00 p* – – –(alb.)	c^4 ♀ *00 p* – – –(alb.)	... ...	... ...	... ...
4*H*38	a^1 ♂ *100xp*22.22.18(5*f*)	a^2 ♂ *100xp*26.26.18(6*f*)	a^3 ♂ *100xp*26.23.17(6*f*)	a^4 ♂ – *p* – – –(3–4*f*)	3*H*2b^3 ♂ *100xp*22.17.18(6*f*)	3*H*1a^4 ♀ *100xp*26.26.23(6*f*)
	a^5 ♂ *45 p*37. 1. 2(3*f*)	a^6 ♂ *50 p*26.23. 2(3*f*)	a^7 ♂ *55 p*26.23. 2(3*f*)	a^8 – *p* – – –	... ...	... ...
	a^9 – *p* – – –	b^1 ♂ *40 p*26.19. 2(2*f*)	b^2 ♂ *70 p*26.23. 2(4*f*)	b^3 ♂ *100xp*23.23.18(6*f*)	... ...	... ...
	b^4 ♂ *100xp*26.26.18(6*f*)	b^5 ♂ *100xp*26.23.18(6*f*)	b^6 ♂ *100xp*26.26.23(6*f*)	b^7 ♀ *100xp*26.26.23(6*f*)	... ...	... ...
	b^8 ♀ – *p* – – –(6*f*)	b^9 – *p* – – –	b^{10} – *p* – – –	b^{11} – *p* – – –	... ...	... ...
	b^{12} – *p* – – –	c^1 ♂ *100xp*22.22.15(6*f*)	c^2 ♂ *100xp*23.23.18(6*f*)	c^3 ♂ *100xp*23.23.18(6*f*)	... ...	... ...
	c^4 ♂ *100xp*26.23.18(6*f*)	c^5 ♂ *100yp*23.23.15(6*f*)	c^6 ♂ *40 p*26. 1. 2(2*f*)	c^7 ♀ *100xp*26.26.23(6*f*)	... ...	... ...
	c^8 ♀ *100xp*23.23.18(6*f*)	... ...	... ...	... ...	... ...	... ...
4*H*39	a^1 ♂ *60 p*26. 1. 2(3*f*)	a^2 ♀ *65 p*26.23. 2(3*f*)	a^3 ♀ *75 p*26.26. 1(4*f*)	a^4 ♀ *100xp*23.23.18(6*f*)	3*H*2b^3 ♂ *100xp*22.17.18(6*f*)	3*H*1a^5 ♀ *100xp*26.23.18(6*f*)
	b^1 ♂ *50 p*26. 1. 2(3*f*)	b^2 ♂ *55 p*26.26. 1(3*f*)	b^3 ♀ *100xp*23.23.18(6*f*)	b^4 ♀ *100xp*17.15.15(6*f*)	... ...	... ...
	c^1 ♀ *100xp*23.23.17(6*f*)	c^2 ♀ *45 p*26. 1. 1(3*f*)	... ...	... ...	... ...	... ...
4*H*40	a^1 ♂ *100xp*15.15.18(6*f*)	a^2 ♂ *100xp*23.23.18(6*f*)	a^3 ♀ *100xp*23.23.17(6*f*)	b^1 ♂ *100xp*23.23.17(6*f*)	3*H*7b^4 ♂ *100xp*23.23.17(6*f*)	3*H*3a^8 ♀ *100xp*15.15.15(6*f*)

	b^2 ♀ *100xp*15.15.15(6*f*)	b^3 ♀ *100xp*15.15.18(6*f*)	c^1 ♀ *100xp*23.23.15(6*f*)	c^2 ♀ *100xp*15.15.15(6*f*)	... ...	... ...
4*H*41	a^1 ♂ *100xp*23.23.18(6*f*)	a^2 ♂ *100xp*23.23.18(6*f*)	a^3 ♂ *100xp*23.23.18(6*f*)	a^4 ♂ – *p* – – –(5*f*)	3*H*11b^1 ♂ *100xp*22.22.15(6*f*)	3*H*11a^2 ♀ *100xp*23.22.17(5*f*)
	a^5 ♂ *100xp*23.23.18(5*f*)	a^6 ♀ *100xp*23.23.17(6*f*)	a^7 – *p* – – – –	a^8 – *p* – – – –	... ...	... ...
	b^1 ♂ *100xp*23.23.18(6*f*)	b^2 ♀ *100xp*26.26.17(6*f*)	c^1 ♂ *100xp*23.23.18(6*f*)	c^2 ♀ *100xp*26.26.23(6*f*)	... ...	... ...
	c^3 ♀ – *p* – – –(6*f*)	... ...	... ...	... ...	... ...	... ...
4*H*43	a^1 ♂ *55 r*41. 1. 2(3*g*)	a^2 ♂ – *r* – – –(4*g*)	a^3 ♂ *80* ? 41.50. 2(4*g*)	a^4 ♂ *100xp*19.19. 9(4–5*b*)	3*H*1b^1 ♂ *65 r*41.50. 3(4*g*)	3*H*13b^3 ♀ – *r* – – –(4*g*)
	a^5 ♀ *60 r*41.41. 1(3–4*g*)	a^6 ♀ *80 p*37. 1. 1(4*b*)	a^7 – *q* – – –	a^8 – *q* – – – –	... ...	... ...
4*H*45	a^1 ♂ *100xp*23.23.17(6*f*)	a^2 ♀ *100xp*23.23.18(6*f*)	a^3 ♀ *100xp*23.23.18(6*fw*)	a^4 – *p* – – – –	3*H*1c^1 ♂ *100xp*22.22.17(6*f*)	3*H*2b^5 ♀ *100xp*22.15.18(6*f*)
	a^5 – *p* – – – –	a^6 – *p* – – – –	a^7 – *p* – – – –	b^1 ♂ *100xp*18. 3. 3(6*f*)	... ...	... ...
	b^2 ♂ *100xp*26.23.18(6*f*)	b^3 ♀ – *p* – – –(6*f*)	b^4 ♀ *100xp*23.23.18(6*f*)	b^5 ♀ *100xporr*23.23.18(6*f*)	... ...	... ...
	b^6 – *p* – – – –	b^7 – *p* – – – –	b^8 – *p* – – – –	b^9 – *p* – – – –	... ...	... ...
	c^1 ♂ *100xp*23.23.15(6*f*)	c^2 ♀ *100xp*15.15.15(6*f*)	c^3 ♀ *100xp*26.23.18(6*f*)	c^4 – *p* – – – –	... ...	... ...
	c^5 – *p* – – – –	c^6 – *p* – – – –	c^7 – *p* – – – –	... ...	... ...	... ...
4*H*46	a^1 ♂ *00 p* – – –(alb.)	a^2 ♂ *00 p* – – –(alb.)	a^3 ♂ *100xq*58.57.56(5*e*)	a^4 ♀ *100xq*58.58.57(6*e*)	3*H*2b^4 ♂ *100xq*57.56.55(5–6*e*)	3*H*11a^6 ♀ *100xq*58.58.55(5–6*e*)
	b^1 ♂ *60 q*58. 1. 1(4*e*)	b^2 ♂ *100yq*57.55. 1(5*e*)	b^3 ♂ *100xq*58.57.55(6*e*)	b^4 ♀ *100xp*17.17.17(6*a–f*)	... ...	... ...
	b^5 – *p* – – – –	b^6 – *p* – – – –	c^1 ♂ *100xq*58.58.55(6*e*)	c^2 ♂ *100xq* 58.57.60(6*e*)	... ...	... ...
	c^3 ♂ *00 p* – – –(alb.)	c^4 ♂ *00 p* – – –(alb.)	c^5 ♀ *100xq*57.57.55(5*e*)	c^6 ♀ *100xq* 58.57.56(6*e*)	... ...	... ...
4*H*47	a^1 ♂ *100xp*22.22.18(6*f*)	a^2 ♂ *100xp*22.22.15(6*f*)	a^3 ♀ *100xq*57.57.55(6*e*)	a^4 ♀ *100xq*58.58.56(6*e*)	3*H*11a^1 ♂ *100xq*57.57.55(5–6*e*)	3*H*9c^2 ♀ *100xq*58.58.55(5*e*)
	a^5 ♀ *00 p* – – –(alb.)	a^6 ♀ *00 p* – – –(alb.)	a^7 – *p* – – –	b^1 ♂ *100xp*23.23.18(6*f*)	... ...	... ...
	b^2 ♀ *100xp*19.19. 8(6*f*)	c^1 ♂ *100xq*58.57.55(6*e*)	c^2 ♂ *100xq*58.57.55(6*e*)	c^3 ♂ *100xq* 57.57.55(6*e*)	... ...	... ...
	c^4 ♂ *100xq*57.57.56(5*e*)	c^5 ♂ *100xp*15.15.18(6*f*)	c^6 ♀ *100xq*58.58.55(6*e*)	c^7 – *p* – – – –	... ...	... ...
4*H*48	a^1 ♂ *00 p* – – –(alb.)	a^2 ♂ *00 p* – – –(alb.)	a^3 ♂ *00 p* – – –(alb.*w*)	a^4 ♀ *00 p* – – –(alb.)	3*H*2c^1 ♂ *100xq*58.58.55(6*e*)	3*H*9c^1 ♀ *100xq*58.58.56(6*e*)
	a^5 ♀ *100xp*23.23.18(6*f*)	a^6 ♀ – *p* – – –(6*f*)	a^7 ♀ *100xq*58.58.56(6*e*)	b^1 ♂ *85 q*58.55. 1(4*e*)	... ...	... ...
	b^2 ♂ *100xp*22.22.18(6*f*)	b^3 ♂ *100zp*23.23.17(6*f*)	b^4 ♀ *100xp*23.15.18(6*fw*)	c^1 ♂ *100xq*58.57.55(6*e*)	... ...	... ...
	c^2 ♂ *100xp*23.23.18(6*f*)	c^3 ♂ *100xp*17.17. 4(6*fw*)	c^4 ♂ *00 p* – – –(alb.)	c^5 ♀ *100xq*58.58.55(6*e*)	... ...	... ...
4*H*49	a^1 ♂ *100xp*26.26.23(6*f*)	a^2 ♂ *100xq*57.57.55(5*e*)	a^3 ♀ *100xq*58.58.55(5*e*)	a^4 – *q* – – – –	3*H*3c^2 ♂ *100xq*57.58.56(6*e*)	3*H*7b^5 ♀ *100xq*58.57.55(5*e*)
	b^1 ♂ *100xq*58.57.55(6*e*)	b^2 ♀ – *q* – – –(6*e*)	b^3 ♀ *100xq*58.58.55(5*e*)	b^4 ♀ *100xp*26.26.23(6*f*)	... ...	... ...
	b^5 – *q* – – – –	b^6 – *q* – – – –	c^1 ♂ *100xq*58.58.55(6*e*)	c^2 ♂ – *q* – – –(6*e*)	... ...	... ...
	c^3 ♀ *100xq*57.57.55(6*e*)	c^4 ♀ *100xq*58.58.55(5*e*)	... ...	... ...	... ...	... ...
4*H*50	a^1 ♂ – *q* – – –(4–5*e*)	a^2 ♂ *70 q*57.57. 1(4*e*)	a^3 ♂ *100xp*19.19.18(6*f*)	a^4 ♀ *100xq*58.56.56(6*e*)	3*H*4c^5 ♂ *95 q*58.55. 2(5*e*)	3*H*1c^7 ♀ *100xq*58.58.56(6*e*)
	a^5 – *q* – – – –	b^1 ♂ *100xq*58.58.55(6*e*)	c^1 ♂ *80 q*58.55. 1(3*e*)	c^2 ♀ *80 q*58.58. 1(4*e*)	... ...	... ...
	c^3 ♀ *70 p*23.23. 1(4*f*)	... ...	... ...	... ...	... ...	... ...
4*H*51	a^1 ♂ *100xq*58.57.55(6*e*)	a^2 ♂ *100xq*57.57.55(5–6*e*)	a^3 ♂ *100xq*58.58.55(6*e*)	a^4 ♀ *100xq*58.57.56(6*e*)	3*H*1c^5 ♂ *100xq*58.58.55(6*e*)	3*H*4c^8 ♀ *100xq*58.57.55(6*e*)
	a^5 ♀ *100xq*57.57.56(5–6*e*)	a^6 ♀ *100xp*23.23.18(6*f*)	a^7 – *p* – – – –	a^8 – *p* – – – –	... ...	... ...
	b^1 ♂ *100xq*58.58.55(6*e*)	b^2 ♂ *100xq*58.58.55(6*e*)	b^3 ♂ *100xq*58.57.55(6*e*)	b^4 ♂ *100xq*58.58.55(6*e*)	... ...	... ...
	b^5 ♀ *100xq*58.57.55(6*e*)	b^6 ♀ *100xp*23.23.18(6*f*)	b^7 ♀ *100xr* 40.40.37(6*g*)	b^8 ♀ *100xr* 40.40.37(6*g*)	... ...	... ...
	c^1 ♂ *100xp*26.23.15(6*f*)	c^2 ♀ *100xq*58.58.55(6*e*)	c^3 ♀ *100xp*23.23.18(6*f*)	c^4 ♀ *100xd.r*40.40.26(6*g*)	... ...	... ...
4*H*52	a^1 ♂ *100xq*58.57.55(6*e*)	a^2 ♂ – *q* – – –(6*e*)	a^3 ♂ *100xp*23.23.18(5*f*)	a^4 ♀ *100xq*58.57.56(6*e*)	3*H*6b^4 ♂ *100xq*58.57.55(5–6*e*)	3*H*5c^1 ♀ *100xq*58.58.55(5*e*)
	b^1 ♂ *100xp*26.23.15(6*f*)	b^2 ♀ *100yq*58.58.56(5*e*)	b^3 – *q* – – – –	b^4 – *q* – – – –	... ...	... ...
	b^5 – *q* – – – –	c^1 ♂ *100yq*58.58.56(5*e*)	... ...	... ...	... ...	... ...
4*H*54	a^1 ♀ *50 q*58. 1. 3(4*e*)	a^2 ♀ – *q* – – –(4*e*)	a^3 ♀ *00 p* – – –(alb.)	b^1 ♂ *95 q*57.55. 1(5*e*)	3*H*16a^3 ♂ *70 q*58.58. 2(4*e*)	3*H*15c^6 ♀ *60 q*58. 1. 3(4*e*)
	b^2 ♂ *75 q*57.56. 3(4*e*)	b^3 ♂ *55 q*58.55. 1(3–4*e*)	b^4 ♂ *65 q*57. 1. 1(4*e*)	b^5 ♀ *65 q*57.55. 1(4*e*)	... ...	... ...
	b^6 ♀ *75 q*58.57. 3(4*e*)	b^7 ♀ *00 p* – – –(alb.)	c^1 ♂ *60 q*57. 1. 1(4*ew*)	c^2 ♂ *45 q*57. 1. 1(3*e*)	... ...	... ...
4*H*55	a^1 ♂ *80 q*58.54. 2(4*e*)	a^2 ♂ – *q* – – –(3*e*)	a^3 ♂ *45 q*61. 1. 2(3*e*)	a^4 ♂ *60 q*58.55. 2(4*e*)	3*H*38a^2 ♂ *75 q*61.58. 2(4*e*)	3*H*15c^7 ♀ – *q* – – –(3*e*)
	a^5 ♀ *70 q*58. 1. 4(4*e*)	a^6 ♀ *00 p* – – –(alb.)	... ...	... ...	... ...	... ...
4*H*56	a^1 ♂ *85 q*57.55. 1(4*e*)	a^2 ♂ *80 q*57. 1. 1(4*e*)	a^3 ♂ *75 q*58. 1. 1(4*e*)	a^4 ♂ *85 q*57.55. 2(4*e*)	3*H*15b^2 ♂ *75 q*58.55. 4(4*e*)	3*H*13b^2 ♀ *70 q*58. 1. 1(4*e*)
	a^5 ♂ *60 q*58. 1. 2(4*e*)	a^6 – *q* – – – –	a^7 – *q* – – – –	a^8 – *q* – – – –	... ...	... ...
	b^1 ♂ *80 q*58.57.52(4*e*)	b^2 ♂ *60 q*58. 1. 1(4*e*)	b^3 ♂ *80 q*57.55. 1(4*e*)	b^4 ♀ *80 q*58.55. 3(4*e*)	... ...	... ...
	b^5 ♀ *90 q*58.55. 1(4*e*)	b^6 – *q* – – – –	b^7 – *q* – – – –	b^8 – *q* – – – –	... ...	... ...
4*H*57	a^1 ♀ *80 q*58.57. 2(4–5*e*)	b^1 ♂ – *q* – – –(6*e*)	b^2 ♂ *00 p* – – –(alb.)	b^3 ♀ *00 p* – – –(alb.)	3*H*15b^3 ♂ – *q* – – –(4*e*)	3*H*16b^1 ♀ *85 q*56.55. 3(4–5*e*)

MATING	OFFSPRING												PARENTS							
													Father				Mother			
4*H*57	b^4	–	*q* – – – –		b^5	–	*q* – – – –		b^6	–	*q* – – – –		b^7	–	*q* – – – –		...	...	...	...	...	...	...	...
	b^8	–	*q* – – – –		b^9	–	*q* – – – –		...	...	...		...	...	...		...	...	...	...	...	...	...	...
4*H*58	a^1 ♂	*35*	*p*23. 1. 2(2*f*)		a^2 ♀	*65*	*q*58. 1. 2(4*e*)		a^3	*55*	*p*23. 1. 1(3*f*)		b^1 ♂	*00*	*p* – – – (alb.)		3*H*1*c*^{2}	♂	*70*	*q*58.58. 2(4*e*)	3*H*16*b*^{3}	♀	*65*	*q*56.58. 1(4*e*)
	b^2 ♂	–	*p* – – – (3*f*)		b^3 ♂	*60*	*p*26. 1. 1(3*f*–*g*)		b^4	–	*q* – – –		b^5	–	*p* – – –		...	...	...	...	...	...	...	...
	b^6	–	*p* – – –		c^1 ♂	*00*	*p* – – – (alb.)		c^2 ♂	*00*	*p* – – – (alb.)		c^3 ♀	*85*	*q*58. 1. 4(4*e*)		...	...	...	...	...	...	...	...
	c^4	–	*p* – – –		c^5	–	*q* – – –		c^6	–	*q* – – –		...	...	...		...	...	...	...	...	...	...	...
4*H*59	a^1 ♂	*70*	*q*58.52. 2(4*e*)		a^2 ♂	*80*	*q*58. 4. 4(4*e*)		a^3 ♂	*80*	*q*58.57. 1(4*e*)		a^4 ♂	*70*	*q*57. 1. 1(3–4*e*)		3*H*15*c*^{3}	♂	*50*	*q*58. 1. 2(3*e*)	3*H*1*c*^{6}	♀	*65*	*q*58.55. 2(4*e*)
	a^5 ♂	*55*	*q*57.57. 1(3*e*)		a^6 ♀	*80*	*q*58.55. 1(4–5*e*)		a^7	–	*q* – – –		a^8	–	*q* – – –		...	...	...	...	...	...	...	...
	b^1 ♂	*55*	*q*58. 1. 1(3*e*)		b^2 ♂	*55*	*q*58. 1. 1(3*e*)		b^3 ♂	–	*q* – – – (4*e*)		b^4 ♂	–	*q* – – – (4*e*)		...	...	...	...	...	...	...	...
	b^5	–	*q* – – –		b^6	–	*q* – – –		b^7	–	*q* – – –		b^8	–	*q* – – –		...	...	...	...	...	...	...	...
	b^9	–	*q* – – –		b^{10}	–	*q* – – –		c^1 ♂	*45*	*q*55. 1. 3(3*e*)		c^2 ♂	*75*	*q*58.55. 2(3–4*e*)		...	...	...	...	...	...	...	...
	c^3 ♂	*60*	*q*58. 1. 1(4*e*)		c^4 ♀	*45*	*q*58. 1. 2(3*e*)		c^5 ♀	*60*	*q*58. 1. 1(3–4*e*)		c^6 ♀	*65*	*q*58. 1. 3(3–4*e*)		...	...	...	...	...	...	...	...
	c^7 ♀	*75*	*q*58.55. 3(4–5*e*)		c^8	–	*q* – – –		c^9	–	*q* – – –		...	...	...		...	...	...	...	...	...	...	...
4*H*60	a^1 ♂	*35*	*q*58. 1. 1(2–3*e*)		a^2 ♂	*35*	*q*58. 1. 1(2–3*e*)		a^3 ♂	*55*	*q*58.57. 1(3*e*)		a^4 ♀	*25*	*q*61. 1. 1(2*e*)		3*H*15*c*^{4}	♂	*30*	*q*58. 1. 1(2–3*e*)	3*H*1*b*^{5}	♀	*45*	*q*55.56. 3(3*e*)
	a^5 ♀	*40*	*q*58. 1. 1(3*e*)		a^6 ♀	*45*	*q*58. 1. 1(3*e*)		a^7	–	*q* – – –		b^1 ♂	*25*	*q*58. 1. 1(1*e*)		...	...	...	...	...	...	...	...
	b^2 ♂	*30*	*q*58. 1. 1(2*e*)		b^3 ♂	–	*q* – – – (3–4*e*)		b^4 ♀	*30*	*q*61.61. 1(1–2*e*)		b^5	–	*q* – – –		...	...	...	...	...	...	...	...
	b^6	–	*q* – – –		b^7	–	*q* – – –		b^8	–	*q* – – –		b^9	–	*q* – – –		...	...	...	...	...	...	...	...
	c^1 ♂	*55*	*q*58. 1. 2(3–4*e*)		c^2 ♂	*65*	*q*58.55. 1(3–4*e*)		c^3 ♀	*85*	*q*58.57. 4(4*e*)		c^4 ♂	–	*q* – – – (2*e*)		...	...	...	...	...	...	...	...
	c^5	–	*q* – – –		c^6	–	*q* – – –		c^7	–	*q* – – –		...	...	...		...	...	...	...	...	...	...	...
4*H*61	a^1 ♂	*75*	*q*58.57. 2(4*e*)		a^2 ♂	*35*	*q*58. 1. 1(2*e*)		a^3 ♀	*70*	*q*61.60. 1(4*e*)		a^4 ♀	*60*	*q*58.57. 3(3*e*)		3*H*15*c*^{5}	♂	*65*	*q*58.58. 2(4*e*)	3*H*40*b*^{6}	♀	*85*	*q*58.56. 2(4–5*e*)
	a^5 ♀	*70*	*q*58.57. 1(4*e*)		a^6 ♀	*95*	*q*58.58.55(4–5*e*)		a^7	–	*q* – – –		a^8	–	*q* – – –		...	...	...	...	...	...	...	...
	b^1 ♂	*60*	*q*58.55. 1(4*e*)		b^2 ♂	*90*	*q*58.57. 2(4–5*e*)		b^3 ♀	–	*q* – – – (2*e*)		c^1 ♂	*90*	*q*58.55. 2(4*e*)		...	...	...	...	...	...	...	...
	c^2 ♂	–	*q* – – – (4*e*)		c^3 ♂	–	*q* – – – (4*e*)		c^4 ♂	*85*	*q*57.55. 2(4*e*)		c^5 ♂	*60*	*q*58.55. 2(4*e*)		...	...	...	...	...	...	...	...
	c^6 ♂	*85*	*q*58.57.55(4*e*)		c^7 ♂	*60*	*q*58.55. 2(3*e*)		c^8 ♂	*35*	*q*58. 1. 2(2*e*)		c^9	–	*q* – – –		...	...	...	...	...	...	...	...
4*H*62	a^1 ♂	*90*	*q*58.55. 2(4*e*)		a^2 ♂	*85*	*q*58.57. 3(4*e*)		a^3 ♂	*95*	*q*58.58.55(4*e*)		a^4 ♀	*85*	*q*57. 1. 1(4*e*)		3*H*15*c*^{1}	♂	*60*	*q*58. 1. 1(4*e*)	3*H*40*b*^{4}	♀	*85*	*q*57.55. 1(4*e*)
	a^5 ♀	*85*	*q*57. 1. 1(4*e*)		a^6 ♀	*00*	*p* – – – (alb.)		a^7	–	*q* – – –		b^1 ♂	*90*	*q*58.57. 4(4–5*e*)		...	...	...	...	...	...	...	...
	b^2 ♂	*85*	*q*58.58. 3(4–5*e*)		b^3 ♂	*90*	*q*57.57. 1(4–5*e*)		b^4 ♂	*00*	*p* – – – (alb.)		b^5 ♀	*90*	*q*58.58. 2(5*e*)		...	...	...	...	...	...	...	...
	b^6	–	*q* – – –		b^7	–	*q* – – –		...	...	...		...	...	...		...	...	...	...	...	...	...	...
4*H*63	a^1 ♂	*80*	*q*57.56. 1(3–4*e*)		a^2 ♂	*60*	*q*57.55. 3(3–4*e*)		a^3 ♂	*00*	*p* – – – (alb.)		a^4 ♂	*00*	*p* – – – (alb.)		3*H*4*c*^{4}	♂	*45*	*q*58.58. 1(2–3*e*)	3*H*40*b*^{7}	♀	*65*	*q*58.57. 2(3*e*)
	a^5 ♀	*50*	*q*58.57. 3(3–4*e*)		a^6 ♀	*60*	*q*58. 1. 3(3–4*e*)		a^7 ♀	*00*	*p* – – – (alb.)		a^8	–	*q* – – –		...	...	...	...	...	...	...	...
	b^1 ♂	*45*	*q*58. 1. 1(2*e*)		b^2 ♂	*55*	*q*58.55. 2(3*e*)		b^3 ♀	*60*	*q*58.57. 2(3*e*)		b^4 ♀	*60*	*q*58. 1. 1(3*e*)		...	...	...	...	...	...	...	...
	b^5 ♀	–	*q* – – – (3–4*e*)		b^6 ♀	*90*	*q*58.57. 1(4*e*)		b^7 ♀	*00*	*p* – – – (alb.)		b^8 ♀	*00*	*p* – – – (alb.)		...	...	...	...	...	...	...	...
	c^1 ♂	*00*	*p* – – – (alb.)		c^2 ♀	–	*q* – – – (2–3*e*)		c^3 ♂	*55*	*q*58. 3. 3(3*e*)		c^4 ♂	*60*	*q*58. 1. 2(3*e*)		...	...	...	...	...	...	...	...
	c^5 ♀	*55*	*q*58. 1. 2(3*e*)		c^6 ♀	*65*	*q*58. 1. 4(4*e*)		c^7	–	*q* – – –		c^8	–	*q* – – –		...	...	...	...	...	...	...	...
	c^9	–	*q* – – –		...	...	... ...		...	...	... ...		...	...	... ...		...	...	...	...	...	...	...	...
4*H*64	a^1 ♂	*55*	*q*58. 1. 2(3*e*)		a^2 ♀	*90*	*q*57.55. 2(4–5*e*)		a^3 ♀	*65*	*q*58. 1. 1(4–5*e*)		a^4 ♀	*65*	*q*58.57. 3(4*e*)		3*H*40*b*^{1}	♂	*90*	*q*58.55. 2(4*e*)	3*H*38*b*^{3}	♀	*75*	*q*58.57. 3(4*e*)
	a^5 ♀	*50*	*q*58. 1. 2(3*e*)		a^6 ♀	*85*	*q*58. 1. 3(4*e*)		b^1 ♂	*85*	*q*58.55. 3(4*e*)		b^2 ♀	*60*	*q*58.57. 3(4*e*)		...	...	...	...	...	...	...	...
	b^3 ♀	*80*	*q*57.57. 3(4*e*)		b^4 ♀	–	*q* – – – (4*e*)		b^5	–	*q* – – –		b^6	–	*q* – – –		...	...	...	...	...	...	...	...
	b^7	–	*q* – – –		b^8	–	*q* – – –		c^1 ♂	*85*	*q*57.55. 1(4*e*)		c^2 ♂	*75*	*q*58.55. 1(4*e*)		...	...	...	...	...	...	...	...
	c^3 ♀	*75*	*q*58.55. 1(3–4*e*)		...	...	... ...		...	...	... ...		...	...	... ...		...	...	...	...	...	...	...	...
4*H*65	a^1 ♂	*55*	*q*58. 1. 1(3*e*)		a^2 ♀	*90*	*q*58.55. 2(4*e*)		a^3 ♀	*95*	*q*58.55. 3(4*e*)		a^4 ♀	*90*	*q*58.55. 2(4*e*)		3*H*14*b*^{1}	♂	*65*	*q*58.58. 2(4*e*)	3*H*38*b*^{4}	♀	*75*	*q*58.57. 2(4*e*)
	a^5 ♀	*75*	*q*45.45. 1(4*ch*)		a^6 ♀	*90*	*q*55.44. 4(4–5*ch*)		a^7 ♀	*00*	*p* – – – (alb.)		a^8 ♀	*00*	*p* – – – (alb.)		...	...	...	...	...	...	...	...
	a^9	–	*p* – – –		b^1 ♀	*55*	*q*57.44. 4(4*ch*)		b^2 ♀	*70*	*q*57.58. 1(4*ch*)		b^3 ♂	*55*	*q*58.58. 1(4*e*)		...	...	...	...	...	...	...	...
	b^4 ♂	*80*	*q*58.55. 3(4*e*)		b^5 ♂	–	*q* – – – (3*e*)		b^6 ♂	*00*	*p* – – – (alb.)		b^7 ♂	*95*	*q*45.45.45(5*ch*)		...	...	...	...	...	...	...	...
	b^8 ♂	*00*	*p* – – – (alb.)		b^9	–	*q* – – –		c^1 ♂	*65*	*q*58.57. 3(4*e*)		c^2 ♂	*00*	*p* – – – (alb.)		...	...	...	...	...	...	...	...
	c^3 ♀	*95*	*q*58.55. 4(4*e*)		c^4 ♀	*95*	*q*58.58.55(4*e*)		c^5	–	*p* – – –		...	...	...		...	...	...	...	...	...	...	...

	b^6 ♂ *00* *p* – – – (alb.)	b^9 – *q* – – – –	c^1 ♂ *65* *q*58.57. 3(*4e*)	c^2 ♂ *00* *p* – – – (alb.)	... ...	... ...	... ...
	c^3 ♀ *95* *q*58.55. 4(*4e*)	c^4 ♀ *95* *q*58.58.55(*4e*)	c^5 – *p* – – – –	... ...	... ...	... ...	... ...

4*H*66	a^1 ♂ *100xq*57.57.55(5*e*)	a^2 ♂ *100xq*58.57.55(5–6*e*)	a^3 ♂ *100yq*58.57.55(5*e*)	a^4 ♂ *55* *q*58.55. 3(3–4*e*)	3*H*6b^5 ♂ *100xq*57.57.56(5*e*)	3*H*38b^6 ♀ *85* *q*57.55. 4(4*e*)
	a^5 ♀ – *q* – – – (6*e*)	a^6 ♀ *100yq*58.58.55(5*e*)	a^7 ♀ *80* *q*58.57. 1(4*e*)	a^8 ♀ *45* *q*58. 1. 4(3*e*)	... ...	... ...
	a^9 – *q* – – – –	b^1 ♂ *40* *q*61. 1. 1(2–3*e*)	b^2 ♂ *55* *q*61. 1. 1(4*e*)	b^3 ♀ *100xq*58.58.57(5*e*)	... ...	... ...
	b^4 ♀ *100xq*57.58.55(6*e*)	b^5 – *q* – – – –	... ...	... ...	... ...	... ...
4*H*67	a^1 ♂ *75* *q*58.57. 2(3–4*e*)	a^2 ♂ *60* *r*41. 1. 2(3–4*g*)	a^3 ♀ *65* *q*61.61. 1(4*e*)	a^4 ♀ *85* *q*58.58. 2(4*e*)	3*H*13b^1 ♂ *60* *q*58.55. 2(3*e*)	3*H*38b^6 ♀ *80* *q*57.55. 6(4*e*)
	a^5 ♀ *55* *q*61. 1. 1(3*e*)	a^6 – *q* – – – –	b^1 ♂ – *l* – – – (4*g*)	b^2 ♂ *75* *p*23. 1.18(3–4*f*)	... ...	... ...
	b^3 ♀ *95* *q*58.58.55(4–5*e*)	b^4 – *p* – – – –	b^5 – *q* – – – –	b^6 – *p* – – – –	... ...	... ...
	b^7 – *q* – – – –	b^8 – *q* – – – –	b^9 – *q* – – – –	b^{10} – *q* – – – –	... ...	... ...
	c^1 ♀ – *q* – – – (4*e*)	c^2 ♀ *65* *q*58.57. 3(4*e*)	c^3 ♀ *65* *q*57. 1. 1(4*e*)	c^4 ♀ *80* *q*58.57. 2(4*e*)	... ...	... ...
	c^5 ♀ *85* *q*58.58. 4(4–5*e*)	c^6 ♀ *90* *q*58.58.55(4–5*e*)	c^7 ♀ *55* *r*41. 1. 1(3*g*)	c^8 – *q* – – – –	... ...	... ...
4*H*69	a^1 ♂ *100xp*39.35. 9(5*b*)	a^2 ♂ *100xp*39.39.36(5*b*)	a^3 ♂ *100xp*39.35.30(5*b*)	a^4 ♀ – *p* – – – (1*b*)	3*H*27b^1 ♂ *30* *p*39. 1. 1(2*b*)	3*H*19b^1 ♀ *100xp*39.39.34(6*b*)
	a^5 ♀ *80* *p*39.39.28(5*b*)	a^6 ♀ *75* *p*39.39.28(5*b*)	a^7 ♀ *100xp*39.39.30(5*b*)	a^8 – *p* – – – –	... ...	... ...
	a^9 – *p* – – – –	b^1 ♂ *100xp*39.39.30(5*b*)	b^2 ♂ *100xp*39.39.28(5*b*)	b^3 ♀ *100yp*22.15.18(5*f*)	... ...	... ...
	c^1 ♀ *80* *p*39.39.30(5*b*)	c^2 ♂ *100xp*39.39.31(6*b*)	c^3 ♂ *100xp*39.33.30(5*b*)	c^4 ♂ *80* *p*39.35. 6(5*b*)	... ...	... ...
	c^5 ♂ *75* *p*39.35. 3(5*b*)	c^6 ♂ *100xp*39.39.28(5*b*)	c^7 – *p* – – – –	... ...	... ...	... ...
4*H*71	a^1 ♂ *30* *p*23. 1. 1(2*fw*)	a^2 ♂ *70* *p*26.23. 1(4*fw*)	a^3 ♀ *95* *p*23.23.18(4*fw*)	a^4 ♀ *65* *p*26. 1. 1(4*fw*)	4*H*10b^1 ♂ *90* *p*26.18. 2(4*fw*)	3*H*3b^8 ♀ *100yp*23.23.18(6*fw*)
	a^5 ♀ – *p* – – – (4*fw*)	b^1 ♂ *90* *p*26.18. 1(3–4*fw*)	b^2 ♀ *100xp*23.23.18(6*fw*)	b^3 ♀ *100xp*19.23.18(6*fw*)	... ...	... ...
	b^4 ♀ *100xp*23.23.18(6*fw*)	... ...	... ...	... ...	... ...	... ...
4*H*73	a^1 ♂ *25* *q*45. 1. 3(1*ch*)	a^2 ♂ – *q* – – – (2*ch*)	a^3 ♂ – *q* – – – (4*ch*)	a^4 ♂ *00* *p* – – – (alb.)	3*H*14c^1 ♂ *40* *q*45. 1. 2(3*ch*)	3*H*14a^5 ♀ – *q* – – – (5*ch*)
	a^5 – *q* – – – –	b^1 ♂ *50* *q*44. 1. 3(4*ch*)	b^2 ♂ *00* *p* – – – (alb.)	b^3 ♀ *30* *q*44. 1. 3(3*ch*)	... ...	... ...
	b^4 ♀ *80* *q*44.44. 3(4*ch*)	b^5 ♀ *00* *p* – – – (alb.)	b^6 . *00* *p* – – – (alb.)	... ...	... ...	... ...
4*H*74	a^1 ♂ *80* *p*39.39.30(5*b*)	a^2 ♂ – *p* – – – (5*b*)	a^3 ♂ *75* *p*39.35. 3(5*b*)	a^4 ♀ *100zp*39.39.28(5*b*)	3*H*53a^2 ♂ *100zp*39.39.29(5*b*)	3*H*57a^6 ♀ *80* *p*39.39. 4(5*b*)
	a^5 ♀ *80* *p*39.35.28(5*b*)	b^1 ♂ *75* *p*39.35. 3(5*b*)	b^2 ♂ – *p* – – – (5*b*)	b^3 ♂ *100zp*39.35.30(5*b*)	... ...	... ...
	b^4 ♀ *100zp*39.35. 3(5*b*)	b^5 – *p* – – – –	b^6 – *p* – – – –	b^7 – *p* – – – –	... ...	... ...
	b^8 – *p* – – – –	c^1 ♀ *95* *p*35.35.30(5*b*)	c^2 ♀ *80* *p*35.35. 3(5*b*)	c^3 ♀ *100zp*39.35.30(5*b*)	... ...	... ...
4*H*75	a^1 ♂ *75* *p*36.36. 4(5*b*)	a^3 ♀ – *p* – – – (5*b*)	a^4 ♀ *100zp*35.36.30(5*b*)	a^5 ♀ *100zp*39.35.30(5*b*)	3*H*57a^1 ♂ *100zp*39.35.28(5*b*)	3*H*52a^2 ♀ *100zp*39.35. 3(5*b*)
	a^6 – *p* – – – –	b^1 ♂ – *p* – – – (5*b*)	b^2 ♂ *100zp*39.35.28(5*b*)	b^3 ♀ *80* *p*40.36.28(5*b*)	... ...	... ...
	b^4 ♀ *75* *p*39.35.28(5*b*)	b^5 ♀ *75* *p*39.39. 4(5*b*)	b^6 – *p* – – – –	b^7 – *p* – – – –	... ...	... ...
	b^8 – *p* – – – –	c^1 ♂ – *p* – – – (5*b*)	c^2 ♂ *75* *p*36.36. 3(5*b*)	c^3 ♀ *80* *p*39.39.28(5*b*)	... ...	... ...
	c^4 ♀ *75* *p*35.35. 3(5*b*)	c^5 ♀ *80* *p*35.35. 3(5*b*)	... ...	... ...	... ...	... ...
4*H*76	a^1 ♂ *45* *p*37. 1. 1(2*b*)	a^2 ♂ *75* *p*35.35. 4(5*b*)	a^3 ♂ *55* *p*35.30. 3(4*b*)	a^4 ♂ *100xp*35.35.30(5*b*)	3*H*53b^3 ♂ *100zp*35.35.30(6*b*)	3*H*54c^3 ♀ *100zp*35.35. 9(5*b*)
	a^5 ♂ *25* *p*37. 1. 1(2*b*)	a^6 ♀ *100zp*35.35.28(5*b*)	a^7 ♀ *80* *p*35.35. 3(5*bw*)	a^8 ♀ *15* *p*39. 1. 1(1*bw*)	... ...	... ...
4*H*77	a^1 ♂ – *p* – – – (6*f*)	a^2 ♂ *100xp*15.15.10(6*f*)	a^3 ♀ *100xp*26.23.15(6*f*)	a^4 ♀ *100xp*15.15.15(6*f*)	3*H*70b^1 ♂ *100xp*15.15.18(6*f*)	3*H*45c^3 ♀ *100xp*23.15.18(6*f*)
	a^5 ♀ *100xp*15.15.18(6*f*)	b^1 ♂ *100xp*23.23.15(6*f*)	b^2 ♂ *100xp*23.23.17(6*f*)	b^3 ♂ *100xp*23.23.18(6*f*)	... ...	... ...
	b^4 ♀ *100xp*23.23.15(6*f*)	b^5 ♀ *100xp*15.15.15(6*f*)	... ...	... ...	... ...	... ...
4*H*79	a^1 ♂ *100xp*23.23.15(5*f*)	a^2 ♂ *100xp*26.26.15(5*f*)	a^3 ♀ *100xp*26.26.23(6*f*)	a^4 – *p* – – – –	3*H*60a^3 ♂ *65* *p*23.15. 1(4*f*)	3*H*64c^3 ♀ *100xp*23.23.17(6*f*)
	a^5 – *p* – – – –	a^6 – *p* – – – –	... ...	... ...	... ...	... ...
4*H*80	a^1 ♂ *100xp*23.23.15(5*f*)	a^2 ♂ *100xp*15.15.15(5*f*)	a^3 ♀ *100xp*23.23.15(6*f*)	a^4 ♀ *100xp*23.23.15(6*f*)	3*H*60a^4 ♂ *50* *p*23.23. 1(3*f*)	3*H*64c^4 ♀ *100xp*13.10.10(6*f*)
	a^5 – *p* – – – –	b^1 ♂ *100xp*23.23.18(6*f*)	b^2 ♂ *100xp*26.26.15(6*f*)	b^3 ♀ *100xp*26.26.23(6*f*)	... ...	... ...
	c^1 ♂ *100xp*15.15.10(6*f*)	c^2 ♂ *100xp*13.13.15(6*f*)	c^3 ♀ *100xp*13.13.15(5*f*)	c^4 ♀ *100xp*13.13.15(5*f*)	... ...	... ...
4*H*82	a^1 ♂ *100xq*58.57.55(6*e*)	a^2 ♂ *65* *q*61.60. 1(3*e*)	a^3 ♀ *85* *q*61.60. 2(4*e*)	b^1 ♂ *00* *p* – – – (alb.)	3*H*71c^1 ♂ *100xq*58.57.55(6*e*)	3*H*67c^3 ♀ *100xq*58.58.55(6*e*)
	b^2 ♀ *85* *q*61.60. 3(4–5*e*)	b^3 ♀ *00* *p* – – – (alb.)	c^1 ♂ *90* *q*58.60. 2(5*e*)	c^2 ♂ *00* *p* – – – (alb.)	... ...	... ...
	c^3 ♀ *100xq*60.57.55(6*e*)	c^4 ♀ *100xq*58.60.55(6*e*)	c^5 ♀ *00* *p* – – – (alb.)	... ...	... ...	... ...
4*H*84	a^1 ♂ *100xq*58.57.55(6*e*)	a^2 ♂ *100xq*58.57.55(6*e*)	a^3 ♂ *100xq*57.55.56(6*e*)	a^4 ♂ *90* *q*58.57.55(5*e*)	3*H*71c^3 ♂ *100xq*57.57.52(5*e*)	3*H*70c^2 ♀ *100xq*58.58.56(6*e*)
	a^5 ♀ *100xq*58.60.55(5*e*)	a^6 ♀ *100xp*23.23.15(6*f*)	b^1 ♂ *60* *q*61. 1. 1(3*e*)	b^2 ♀ *100xq*58.57.55(6*e*)	... ...	... ...
	b^3 ♀ *100xq*58.57.55(6*e*)	b^4 ♀ *100xq*58.58.55(6*e*)	b^5 ♀ *100xq*58.58.55(5–6*e*)	c^1 ♂ *100xq*58.60.55(6*e*)	... ...	... ...
	c^2 ♂ *60* *q*61. 1. 2(3*e*)	c^3 ♀ *100xq*58.58.60(6*e*)	c^4 ♀ *100xq*58.60.55(5–6*e*)	c^5 ♀ *80* *q*58.60.60(3*e*)	... ...	... ...
4*H*85	a^1 ♂ *100xq*57.60.55(6*e*)	a^2 ♂ *100xq*57.60.60(6*e*)	a^3 ♂ *100xp*18.15.15(6*f*)	a^4 ♀ *100xp*23.23 18(6*f*)	3*H*70c^1 ♂ *65* *q*58. 1. 1(3*e*)	3*H*45c^2 ♀ *100xq*58.58.55(6*e*)
	a^5 ♀ *100xp*22.22.17(6*f*)	b^1 ♀ *100xq*61.31.60(6*e*)	b^2 ♀ *100xq*61.60.60(6*e*)	... ...	... ...	... ...
4*H*87	a^1 ♀ *70* *r*41.41. 4(3–4*g*)	... ...	... ...	... ...	3*H*59a^1 ♂ *100xq*41.41.50(6*e*–*g*)	3*H*59c^4 ♀ *80* *r*41.50. 1(4*g*)

MATING	OFFSPRING				PARENTS	
					Father	Mother
5*H*1	a^1 ♀ *100xp*26.23.15(6*f*)	a^2 ♀ *100xp*23.23.22(6*f*)	a^3 ♀ *100xp*26.26.23(6*f*)	a^4 ♀ *100xp*23.23.17(6*f*)	4*H*17 {a^1 ♂ *100xp*23.23.18(6*f*), a^2 ♂ *100xp*26.26.17(6*f*)}	4*H*17a^3 ♀ *100xp*23.23.18(6*f*)
	a^5 – *p* – – –(6*f*)	... ...	... ...	... ...	... ...	... ...
5*H*3	? – *p* – – – –	a^1 ♂ *100xp*13.13.15(6*f*)	a^2 ♂ *100xp*26.26.23(6*f*)	a^3 ♂ *100xp*24.24.17(6*f*)	4*H*27a^2 ♂ *100xp*23.23.18(6*f*)	4*H*22a^6 ♀ *100xp*23.23.18(6*f*)
	a^4 ♂ *100xp*23.23.17(6*f*)	a^5 ♀ *100xp*13.13.18(6*f*)	a^6 ♀ *100xp*23.23.17(6*f*)	a^7 ♀ – *p* – – –(6*f*)	... ...	... ...
5*H*4	a^1 ♀ *100xp*15.15.15(6*f*)	a^2 ♀ *100xp*23.23.15(6*f*)	a^3 ♀ *100xp*23.23.17(6*f*)	a^4 ♀ *100xp*15.15.15(6*f*)	4*H*17a^1 ♂ *100xp*23.23.18(6*f*)	4*H*20a^4 ♀ *100xp*23.23.15(6*f*)
	a^5 – *p* – – – –	b^1 ♂ *100xp*22.15.15(6*f*)	b^2 ♂ *100xp*22.22.17(6*f*)	b^3 ♀ *100xp*26.23.15(6*f*)	... ...	... ...
	c^1 ♂ *100xp*23.23.15(6*f*)	c^2 ♂ *100xp*17.17.15(6*f*)	c^3 ♂ *100xp*22.22.15(6*f*)	c^4 ♀ *100xp*23.23.17(6*f*)	... ...	... ...
	c^6 ♀ *00 p* – – –(alb.)	... ...	... ...	... ...	... ...	... ...
5*H*5	a^1 ♂ *100xp*15.15.10(6*f*)	a^2 ♂ *100xp*15.15.10(6*f*)	a^3 ♂ *100xp*23.23.15(6*f*)	a^4 ♂ *100xp*23.23.15(6*f*)	4*H*28a^1 ♂ *100xp*23.23.17(5*f*)	4*H*20a^5 ♀ *100xp*10.23.15(6*f*)
5*H*6	a^1 ♀ *100xp*23.23.15(6*f*)	a^2 ♀ *100xp*23.23.15(6*f*)	a^3 ♀ *100xp*26.23.17(6*f*)	a^4 – *p* – – –	4*H*15a^2 ♂ *100xp*23.23.18(6*f*)	4*H*27a^4 ♀ *100xp*23.23.18(5*f*)
	b^1 ♂ *100xp*23.23.15(6*f*)	b^2 ♂ *100xp*23.23.17(6*f*)	b^3 ♀ *100xp*23.23.15(6*f*)	b^4 ♀ *100xp*26.23.10(6*f*)	... ...	... ...
	b^5 ♀ *100xp*26.23.15(5*f*)	... ...	... ...	... ...	... ...	... ...
5*H*7	a^1 ♂ *100xp*23.23.17(6*fw*)	a^2 ♂ *100xp*23.23.15(6*fw*)	a^3 ♂ *100xp*23.15.17(6*f*)	a^4 ♂ *100xp*26.26.23(5*f*)	4*H*4a^1 ♂ *100xp*23.23.18(6*f*)	4*H*27a^6 ♀ *100xp*23.23.17(6*f*)
	a^6 ♀ *100xp*23.23.18(6*f*)	a^6 ♀ *100xp*23.23.18(6*fw*)	b^1 ♂ *100xp*23.23.17(6*f*)	b^2 ♂ *100xp*23.23.17(6*f*)	... ...	... ...
	b^3 ♂ *95 p*23.23.17(4–5*f*)	b^4 ♀ *100xp*23.23.17(6*f*)	b^5 ♀ *100xp*26.23.17(6*f*)	... ...	... ...	... ...
5*H*8	a^1 ♂ *100xp*26.23.15(5*f*)	a^2 ♀ *100xp*23.23.17(6*f*)	a^3 ♀ *95 p*15.15.18(5*f*)	a^4 ♀ *100xp*22.22.18(5*f*)	4*H*17a^2 ♂ *100xp*26.26.17(6*f*)	4*H*19a^5 ♀ *30 p*23. 1. 2(2–3*f*)
	a^6 – *p* – – – –	b^1 ♂ *100xp*26.26.17(6*f*)	b^2 ♂ *100xp*23.23.15(6*f*)	b^3 ♂ *100xp*26.23.17(5*f*)	... ...	... ...
	b^4 ♀ *100xp*26.23.17(6*f*)	b^5 ♀ *100xp*23.23.18(5*f*)	b^6 – *p* – – – –	c^1 ♂ – *p* – – –(6*f*)	... ...	... ...
	c^2 ♂ – *p* – – –(6*f*)	c^3 ♂ *100yp*26.2[illegible]?(5*f*)	c^4 ♂ *100xp*26.23.15(5*f*)	c^5 ♀ *100xp*23.23.18(6*f*)	... ...	... ...
	c^6 ♀ *100xp*26.23.15(6*f*)	c^7 – *p* – – – –	c^8 – *p* – – – –	... ...	... ...	... ...
5*H*10	a^1 ♂ *100xq*58.55.55(6*e*)	a^2 ♂ *100xq*58.57.55(6*e*)	a^3 ♂ *100xq*57.55.55(5*e*)	a^4 ♀ *100xq*58.58.55(6*e*)	4*H*1a^1 ♂ *100xq*58.57.55(6*e*)	4*H*4a^4 ♀ *100xq*58.57.55(5*e*)
	a^5 ♀ *100xq*58.58.55(5*e*)	a^6 – *q* – – – –	a^7 – *q* – – – –	... ...	... ...	... ...
5*H*11	a^1 ♂ *100xq*58.57.55(6*e*)	a^2 ♂ *100xq*58.57.56(6*e*)	a^3 ♂ *100xq*58.57.56(6*e*)	a^4 ♂ *100xq*58.57.55(6*e*)	4*H*1a^2 ♂ *100xq*58.57.55(6*e*)	4*H*2a^7 ♀ *100xq*58.58.57(6*e*)
	a^5 ♂ – *q* – – –(6*e*)	a^6 – *q* – – – –	b^1 ♂ *100xq*57.56.55(6*e*)	b^2 ♂ *100xq*57.56.55(6*e*)	... ...	... ...
	b^3 ♀ *100xq*58.57.56(6*e*)	b^4 ♀ *100xq*58.57.55(6*e*)	b^5 ♀ *100xq*58.58.56(6*e*)	c^1 ♂ *100xq*58.57.55(6*e*)	... ...	... ...
	c^2 ♂ *100xq*58.57.55(6*e*)	c^3 ♂ *100xq*57.57.56(6*e*)	c^4 ♂ *100xq*58.57.55(6*e*)	c^5 ♂ *100xq*58.57.56(6*e*)	... ...	... ...
	c^6 ♀ *100xq*58.58.55(6*e*)	c^7 – *q* – – – –	... ...	... ...	... ...	... ...
5*H*12	a^1 ♂ *100xq*58.57.55(6*e*)	a^2 ♂ *100xq*57.57.55(6*e*)	a^3 ♂ *100xq*57.57.55(6*e*)	a^4 ♀ *100xq*58.58.55(6*e*)	4*H*1a^3 ♂ *100xq*58.57.55(6*e*)	4*H*7a^2 ♀ *100xq*58.57.56(5–6*e*)
	b^1 ♂ *100xq*58.58.55(5–6*e*)	b^2 ♀ *100xq*58.57.55(6*e*)	b^3 – *q* – – – –	b^4 – *q* – – – –	... ...	... ...
	b^5 – *q* – – – –	b^6 – *q* – – – –	b^7 – *q* – – – –	... ...	... ...	... ...
5*H*14	a^1 ♂ *100xr*41.41.26(6*g*)	a^2 ♀ *100xq*58.57.56(6*e*)	a^3 ♀ *100xq*58.57.56(6*e*)	a^4 ♀ *100xq*58.57.56(5–6*e*)	4*H*7a^1 ♂ *100xq*58.57.55(5*e*)	4*H*24a^2 ♀ – *q* – – –(5–6*e*)
	a^5 ♀ *00 p* – – –(alb.)	a^6 ♀ *00 p* – – –(alb.)	a^7 – *p* – – – –	... ...	... ...	... ...
5*H*15	a^1 ♂ *100xq*58.57.55(6*e*)	a^2 ♂ *100xq*57.57.55(6*e*)	a^3 ♂ *100xq*58.57.55(6*e*)	a^4 – *q* – – –	4*H*24a^1 ♂ *100xq*58.57.55(5–6*e*)	4*H*26a^5 ♀ *100xq*58.58.56(6*e*)
	b^1 ♂ *100xq*58.57.55(6*e*)	b^3 ♂ *100xq*57.57.55(5*e*)	b^3 ♀ *100xq*58.58.55(6*e*)	b^4 ♀ *100yq*58.57. 2(5*e*)	... ...	... ...
	b^5 ♂ *100xq*58.58.56(6*e*)	c^1 ♂ *100yq*58.58. 2(5*e*)	c^2 ♀ *100xq*58.58.55(5*e*)	... ...	... ...	... ...
5*H*17	a^1 ♂ *100xq*58.57.56(6*e*)	a^2 ♂ *100xq*58.57.56(6*e*)	a^3 ♂ *100xq*58.57.56(6*e*)	a^4 ♂ *100xp*37.37.18(6*f*)	4*H*25a^1 ♂ *100xq*57.57.56(6*e*)	4*H*25a^2 ♀ *100xq*58.58.55(6*e*)
	a^5 ♀ *100xq*58.57.55(6*e*)	a^6 ♀ *100xq*58.57.55(6*e*)	a^7 ♀ *100xp*15.15.18(6*f*)	a^8 – *p* – – –	... ...	... ...
	b^1 ♂ *100xq*56.57.55(6*e*)	b^2 ♂ *100xq*58.58.55(6*e*)	b^3 ♂ *100xp*17.17.18(6*f*)	b^4 ♀ *100xq*58.57.55(6*e*)	... ...	... ...
	b^5 ♀ *100xp*23.23.15(6*f*)	b^6 ♀ *100xp*23.23.18(6*f*)	c^1 ♂ *100xq*58.58.55(6*e*)	c^3 ♂ *100xq*57.57.56(6*e*)	... ...	... ...
	c^3 ♂ *100xq*58.58.55(6*e*)	c^4 ♀ *100xq*58.57.55(6*e*)	c^5 ♀ *100xq*58.58.57(6*e*)	c^6 ♀ *100xp*22.22.18(6*f*)	... ...	... ...
5*H*18	a^1 ♀ *70 q*58. 1. 1(4*ew*)	a^2 ♀ *50 q*58. 1. 1(3*ew*)	a^3 ♀ *45 q*58. 1. 1(3*ew*)	a^4 ♀ *45 q*58. 1. 1(2*ew*)	4*H*13a^4 ♂ – *q* – – –(3–4*ew*)	4*H*10a^3 ♀ *55 q*58. 1. 2(3*ew*)
5*H*19	a^1 ♂ *100xr*41.41.26(6*g*)	a^2 ♂ *100xr*41.41.26(6*g*)	a^3 ♀ *100xr*41.41.50(6*g*)	a^4 ♀ *100xr*41.41.26(6*g*)	4*H*12b^1 ♂ *65 r*41.50. 2(3–4*g*)	4*H*1a^6 ♀ *100xr*41.41.50(6*g*)
	a^5 ♀ *100xq*41.41.50(6*g*)	a^6 ♀ – *q* – – –(6*g*)	b^1 ♂ *100xr*41.41.26(5*g*)	b^2 ♂ *100xr*41.41.26(6*g*)	... ...	... ...
	b^3 ♀ *100xr*41.26.26(6*g*)	b^4 ♀ – *r* – – –(5–6*g*)	b^5 ♀ *100xr*41.41.26(5–6*g*)	b^6 ♀ *100xq*or*r*41.41.26(6*g*)	... ...	... ...

	b^7 – q – – – –	b^8 – q – – – –	b^9 – q – – – –	c^1 ♀ *100xr* 41.41.26(6*g*)	… … … …	… … … …			
	c^2 ♀ *100xr* 41.41.26(6*g*)	c^3 ♀ *100xr* 41.41.50(6*g*)	c^4 ♀ *100xr* 50.50.23(5*g*)	c^5 ♀ *100yr* 41.50.50(5*g*)	… … … …	… … … …			
	c^6 ♀ *100xr* 41.50.50(5*g*)	c^7 ♀ – r – – – (5*g*)	c^8 – q – – – –	… … …	… … … …	… … … …			
5*H*20	a^1 ♂ *100xq*58.57.60(5*e*)	a^2 ♂ *60* *q*58.58. 1(4*ew*)	a^3 ♀ *100xq*58.58.55(5*e*)	a^4 ♀ *100xq*58.58.55(5*e*)	4*H*13a^2 ♂ *90* *q*58.56. 2(4–5*e*)	4*H*6a^2 ♀ *95* *q*58.57.55(5*e*)			
	a^5 ♀ *45* *q*58. 1. 1(3*e*)	a^6 ♀ *45* *q*58.58. 1(3*e*)	a^7 – q – – – –	a^8 – q – – – –	… … … …	… … … …			
	a^9 – q – – – –	b^1 ♂ – q – – – (5*e*)	b^2 ♂ *80* *q*58.57. 1(4*e*)	b^3 ♀ *100xq*58.57.55(5*e*)	… … … …	… … … …			
	b^4 – q – – – –	b^5 – q – – – –	b^6 – q – – – –	b^7 – q – – – –	… … … …	… … … …			
	b^8 – q – – – –	b^9 – q – – – –	b^{10} – q – – – –	… … …	… … … …	… … … …			
5*H*21	a^1 ♂ *90* *q*58.58.55(4*e*)	a^2 ♂ *75* *q*58.55. 2(4*e*)	a^3 ♂ *80* *q*58.55. 2(4*e*)	a^4 ♀ *40* *q*61. 1. 1(2–3*e*)	4*H*10a^1 ♂ *75* *q*58.55. 2(4*e*)	4*H*3a^4 ♀ *55* *q*58. 1. 2(3*e*)			
	a^5 ♀ *60* *q*61.61. 1(3*e*)	a^6 ♀ *50* *q*61.61. 1(3*e*)	a^7 ♀ *55* *q*58. 2. 2(3–4*e*)	a^8 ♀ – q – – – (5*e*)	… … … …	… … … …			
	a^9 ♀ – q – – – (5*e*)	b^1 ♂ *60* *q*61. 1. 1(4*e*)	b^2 ♂ *75* *q*58.55. 1(4*e*)	b^3 ♀ *50* *q*61. 1. 2(3*e*)	… … … …	… … … …			
	b^4 ♀ *50* *q*58. 1. 2(3*e*)	b^5 ♀ *80* *q*58.58. 1(4*e*)	b^6 ♀ *95* *q*57.55. 1(4*e*)	b^7 ♀ *60* *q*58.58. 1(4*e*)	… … … …	… … … …			
	b^8 – q – – – –	c^1 ♂ *85* *q*58.55. 1(4*e*)	c^2 ♂ *90* *q*58.55. 3(4*e*)	c^3 ♀ *60* *q*61.61. 1(3–4*e*)	… … … …	… … … …			
	c^4 ♀ *60* *q*58.58. 1(3–4*e*)	c^5 ♀ *85* *q*58.57. 1(4*e*)	… … …	… … …	… … … …	… … … …			
5*H*22	a^1 ♂ *80* *q*52.47. 2(4*e*)	a^2 ♂ *55* *q*58.47. 2(3*e*)	a^3 ♂ *00* p – – – (alb.)	a^4 ♀ *65* *q*56.55. 4(3*e*)	4*H*13a^3 ♂ *90* *q*58.55. 2(4–5*e*)	4*H*2a^6 ♀ *90* *q*57.55. 1(5*e*)			
	a^5 ♀ *60* *q*58. 1. 4(3*e*)	a^6 – q – – – –	a^7 – q – – – –	b^1 ♂ – q – – – (4*e*)	… … … …	… … … …			
	b^2 ♂ *85* *q*58.55. 1(4*e*)	b^3 ♂ *00* p – – – (alb.)	b^4 ♀ *00* p – – – (alb.)	b^5 ♀ *90* *q*58.55. 2(5*e*)	… … … …	… … … …			
	b^6 ♀ *85* *q*57.55. 1(4*e*)	b^7 ♀ *95* *q*58.58. 2(5*e*)	b^8 ♂ *50* *q*45.45. 3(3*e*)	… … …	… … … …	… … … …			
5*H*23	a^1 ♀ *20* r 42. 1. 1(1*gw*)	b^1 ♂ *30* *q*58. 1. 1(2*e*)	b^2 ♂ *35* *q*41.26. 1(3*g*)	b^3 ♂ *00* p – – – (alb.)	4*H*13a^5 ♂ *40* *q*58. 1. 2(3*e*)	4*H*1a^4 ♀ *45* *q*58. 1. 1(3*e*)			
	b^4 ♀ *40* *q*58. 1. 2(2*ew*)	b^5 ♀ *55* *q*61. 1. 1(2*e*)	b^6 ♀ *35* *q*42.50. 1(2*g*)	c^1 ♂ *35* *q*61. 1. 1(2*e*)	… … … …	… … … …			
	c^2 ♂ – q – – – (3*e*)	c^3 ♂ *75* r41.41. 1(4*g*)	c^4 ♀ *40* *q*41.41. 2(3*g*)	c^5 ♀ *00* p – – – (alb.)	… … … …	… … … …			
	c^6 ♀ *00* p – – – (alb.)	c^7 – q – – – –	… … …	… … …	… … … …	… … … …			
5*H*24	a^1 ♂ *80* *q*58.57. 2(4*e*)	a^2 ♂ *75* *q*58.55. 2(4*e*)	a^3 ♂ *90* r41.26. 1(4*g*)	a^4 ♀ *00* p – – – (alb.)	4*H*2a^1 ♂ *70* *q*58.55. 2(4*e*)	4*H*11a^1 ♀ *95* *q*58.56. 2(4–5*e*)			
	a^5 ♀ *55* *q*58. 1. 1(2–3*e*)	a^6 – p – – – –	a^7 – q – – – –	b^1 ♂ *95* *q*58.55. 2(4*e*)	… … … …	… … … …			
	b^2 ♀ *45* *q*58.58. 1(3*e*)	b^3 ♀ *60* *q*58.57. 1(3*e*)	c^1 ♂ *90* *q*57.55. 1(4*e*)	c^2 ♂ *55* *q*58. 1. 2(3*e*)	… … … …	… … … …			
	c^3 ♂ *45* *p*23. 1. 1(3*f*)	c^4 ♂ *90* *p*22.15. 1(4*f*)	c^5 ♂ *00* p – – – (alb.)	c^6 ♀ *00* p – – – (alb.)	… … … …	… … … …			
5*H*25	a^1 ♂ *100xq*58.58.55(6*e*)	a^2 ♂ *100xq*58.57.55(6*e*)	a^3 ♀ *100xq*58.58.55(6*e*)	a^4 ♀ *100xq*57.57.55(6*e*)	4*H*2b^2 ♂ *100xq*58.57.56(6*e*)	4*H*3b^8 ♀ *100xq*58.57.56(6*e*)			
	a^5 – q – – – –	a^6 – q – – – –	b^1 ♂ *100xq*58.58.55(6*e*)	b^2 ♂ – p – – – (6*f*)	… … … …	… … … …			
	b^3 ♂ – p – – – (6*f*)	b^4 ♂ *40* *p*37. 1. 1(3*f*)	b^5 ♀ *100xq*58.58.55(6*e*)	b^6 ♀ *100xp*22.22.17(6*f*)	… … … …	… … … …			
	c^1 ♂ *100xq*58.57.55(6*e*)	c^2 ♂ – q – – – (6*e*)	c^3 ♂ – q – – – (6*e*)	c^4 ♂ *90* *q*58.55. 2(4*e*)	… … … …	… … … …			
	c^5 ♀ *100xp*26.26.23(6*f*)	c^6 – q – – – –	… … …	… … …	… … … …	… … … …			
5*H*26	a^1 ♂ *80* *q*57.55. 1(3*e*)	a^2 ♂ *55* *q*58.58. 1(3–4*e*)	a^3 ♀ *75* *q*57.56. 1(3–4*e*)	b^1 ♂ *60* *q*57. 4. 4(4*e*)	4*H*67a^1 ♂ *75* *q*58.57. 2(3–4*e*)	4*H*65a^4 ♀ *90* *q*58.55. 2(4*e*)			
	b^2 ♂ *90* *q*57.55. 1(4*e*)	b^3 ♀ – q – – – (5*e*)	b^4 ♀ *65* *q*58.55. 1(3–4*e*)	b^5 ♀ *45* *q*58. 1. 1(2–3*e*)	… … … …	… … … …			
	c^1 ♂ *90* *q*58.57. 1(5*e*)	c^2 ♂ *65* *q*58.57. 1(4*e*)	c^3 ♂ *60* *q*58. 1. 1(3*e*)	c^4 ♀ *90* *q*58.55. 2(4*e*)	… … … …	… … … …			
	c^6 ♀ *65* *q*58.57. 2(4*e*)	… … …	… … …	… … …	… … … …	… … … …			
5*H*27	a^1 ♂ – q – – – (3*e*)	a^2 ♂ *55* *q*58. 1. 1(3*e*)	a^3 ♀ – q – – – (3*e*)	a^4 ♀ *50* *q*57.56. 1(3*e*)	4*H*65a^1 ♂ *55* *q*58. 1. 1(3*e*)	4*H*67a^5 ♀ *55* *q*61. 1. 1(3*e*)			
	a^5 ♀ *50* *q*58.58. 1(3*e*)	a^6 ♀ – q – – – (3*e*)	b^1 ♂ *60* *q*58. 1. 1(4*e*)	b^2 ♀ *55* *q*58. 1. 2(4*e*)	… … … …	… … … …			
	b^3 ♀ *85* *q*58.57. 1(4*e*)	b^4 ♀ *45* *q*58. 1. 1(3*e*)	b^5 ♀ *80* *q*57.57. 1(4*ch*)	b^6 ♀ – q – – – (4*ch*)	… … … …	… … … …			
	b^7 ♀ *65* *q*58. 1. 1(4*e*)	b^8 ♀ *75* *q*58.57. 3(4*e*)	b^9 ♂ – q – – – (3*e*)	c^1 ♂ *85* *q*58.44. 1(4*e*)	… … … …	… … … …			
	c^2 ♀ *35* *q*44. 1. 1(3*ch*)	c^3 ♂ *40* *q*52. 1. 1(3*ch*)	c^4 ♀ *60* *q*58. 1. 3(4*e*)	c^5 ♂ *50* *q*61.60. 1(3*e*)	… … … …	… … … …			
	c^6 ♀ *75* *q*58.56. 1(4*e*)	c^7 ♀ *60* *q*58.58. 1(4*e*)	c^8 ♀ *80* *q*57.58.12(4*e*)	c^9 – q – – – –	… … … …	… … … …			
	c^{10} – q – – – –	… … …	… … …	… … …	… … … …	… … … …			
5*H*29	a^1 ♂ *100xq*57.57.56(5*e*)	a^2 ♀ *100xq*58.58.56(6*e*)	a^3 ♀ *100xq*58.57.55(6*e*)	a^4 ♀ *100xq*57.57.56(5*e*)	4*H*30a^1 ♂ *100xq*58.57.55(6*e*)	4*H*37a^3 ♀ *100xq*58.57.56(6*e*)			
	a^5 – p – – – –	b^1 ♂ *100xq*58.58.57(5*e*)	b^2 ♂ *100xq*58.57.56(5*e*)	b^3 ♀ *100xq*58.57.56(6*q*)	… … … …	… … … …			
	b^4 ♀ *100xq*58.58.55(6*e*)	b^5 ♀ *00* p – – – (alb.)	c^1 ♂ *100xq*58.58.55(6*e*)	c^2 ♂ – q – – – (6*e*)	… … … …	… … … …			
	c^3 ♀ *100xq*58.58.56(6*e*)	c^4 ♂ *100xq*58.58.55(6*e*)	c^5 ♀ *100xq*57.57.56(5*e*)	… … …	… … … …	… … … …			
5*H*30	a^1 ♂ *100xp*22.22.18(6*f*)	a^2 ♂ *00* p – – – (alb.)	a^3 ♀ *100xp*23.23.18(6*f*)	a^4 ♀ *100xq*58.58.55(6*e*)	4*H*30a^2 ♂ *100xq*58.57.55(6*e*)	4*H*37a^5 ♀ *100xq*58.58.55(6*e*)			
	a^6 ♀ *100xq*58.58.55(5*e*)	a^9 – p – – – –	a^7 – p – – – –	a^8 – p – – – –	… … … …	… … … …			
	b^1 ♂ *00* p – – – (alb.)	b^3 ♂ *100xp*23.23.15(6*f*)	b^7 ♀ *100xp*15.15.18(6*f*)	b^4 ♀ *100xp*23.23.15(6*f*)	… … … …	… … … …			
	b^5 ♀ *100xq*58.58.55(6*e*)	b^6 ♀ *100xq*58.57.55(6*e*)	b^7 ♀ *00* p – – – (alb.)	c^1 ♂ *100xp*15.15.15(6*f*)	… … … …	… … … …			

MATING	OFFSPRING				PARENTS	
					Father	Mother
5*H*30	c^2 ♀ *100xq*58.58.55(6*e*)	c^3 ♀ *100xq*58.56.55(6*e*)	c^4 ♀ *100xq*58.58.55(6*e*)	c^5 ♀ *100xq*58.58.55(6*e*)	... ...	... ...
	c^6 ♀ *00 p – – –*(alb.)	c^7 *– q – – – –*	... ...	... ...	... ...	... ...
5*H*31	a^1 ♂ *100xq*58.58.57(6*e*)	a^2 ♂ *100xp*23.23.18(6*f*)	a^3 ♀ *100xq*58.58.55(6*e*)	a^4 ♀ *100xq*58.57.55(6*e*)	4*H*30a^3 ♂ *100xq*58.57.55(6*e*)	4*H*50a^4 ♀ *100xq*58.56.56(6*e*)
	a^5 ♀ *100xq*58.58.55(6*e*)	a^6 ♀ *100xq*58.57.55(6*e*)	a^7 ♀ *100xp*23.23.18(6*f*)	a^8 *– q – – – –*	... ...	... ...
	a^9 *– q – – – –*	b^1 ♂ *100xq*58.58.55(6*e*)	b^2 ♂ *100xp*26.23.15(6*f*)	b^3 ♂ *100xq*58.58.55(5–6*e*)	... ...	... ...
	b^4 ♂ *100yq*57.57.56(5–6*e*)	b^5 ♂ *100xq*58.58.55(6*e*)	b^6 ♂ *100xq*58.58.55(5*e*)	b^7 ♀ *100xq*58.57.56(6*e*)	... ...	... ...
	b^8 ♀ *100xp*22.22.18(6*f*)	b^9 ♀ *100xp*15.15.18(6*f*)	b^{10} *– q – – – –*	c^1 ♂ *100xq*58.58.57(6*e*)	... ...	... ...
	c^3 ♂ *100xq*58.58.57(6*e*)	c^3 ♂ *100xq*58.58.55(6*e*)	c^4 ♂ *100xq*58.58.55(6*e*)	c^5 ♂ *100xp*26.26.23(6*f*)	... ...	... ...
	c^8 ♀ *100xq*58.58.55(6*e*)	c^7 ♀ *100xq*58.58.57(6*e*)	c^8 ♀ *– q – – –*(6*e*)	c^9 ♀ *– p – – –*(6*f*)	... ...	... ...
	c^{10} ♀ *– p – – –*(6*f*)	... ...	... ...	... ...	... ...	... ...
5*H*32	a^1 ♂ *– q – – –*(6*e*)	a^2 ♂ *100xq*58.58.55(6*e*)	a^3 ♀ *– q – – –*(6*e*)	a^4 ♀ *100xq*58.57.55(6*e*)	4*H*51a^1 ♂ *100xq*58.57.55(6*e*)	4*H*30a^4 ♀ *100xq*58.57.55(6*e*)
	a^5 ♀ *90 q*58.58. 1(4*e*)	a^6 ♀ *00 p – – –*(alb.)	b^1 ♂ *100xq*58.57.55(5*e*)	b^2 ♀ *00 p – – –*(alb.)	... ...	... ...
	b^3 ♀ *100xq*58.58.55(6*e*)	b^4 ♀ *100xq*58.57.55(6*e*)	b^5 *– q – – – –*	c^1 ♂ *100xq*58.57.55(6*e*)	... ...	... ...
	c^2 ♀ *100xq*58.58.56(6*e*)	c^3 ♀ *100xq*58.57.55(6*e*)	c^4 ♀ *00 p – – –*(alb.)	c^5 *– q – – – –*	... ...	... ...
	c^6 *– q – – – –*	... ...	... ...	... ...	... ...	... ...
5*H*33	a^1 ♂ *100xq*57.57.55(6*e*)	a^2 ♂ *100xq*58.57.56(6*e*)	a^3 ♀ *100xq*55.55.54(6*e*)	a^4 ♀ *100xq*58.57.55(6*e*)	4*H*50b^1 ♂ *100xq*58.58.55(6*e*)	4*H*30a^5 ♀ *100xq*58.57.55(6*e*)
	b^1 ♂ *100xp*23.15.18(6*f*)	b^2 ♂ *100xq*58.57.55(6*e*)	b^3 ♂ *100xq*58.58.55(6*e*)	b^4 ♂ *100xq*58.57.55(6*e*)	... ...	... ...
	b^5 ♀ *100xq*58.57.56(6*e*)	b^6 ♀ *100xq*58.57.55(6*e*)	b^7 ♀ *100xq*58.57.55(5*e*)	... ...	... ...	... ...
5*H*34	a^1 ♂ *100xp*23.23.15(6*f*)	a^2 ♀ *100xq*58.57.55(6*e*)	a^3 ♀ *100xq*58.58.55(6*e*)	a^4 ♀ *100xq*58.58.56(6*e*)	4*H*51 { b^2 ♂ *100xq*58.58.55(6*e*) ; b^3 ♂ *100xq*58.57.55(6*e*) }	4*H*30a^6 ♀ *100xq*58.57.56(6*e*)
	a^5 ♀ *100xq*58.58.57(6*e*)	a^6 ♀ *100xp*23.23.18(6*f*)	b^1 ♂ *100xq*58.57.55(6*e*)	c^1 ♂ *100xq*58.58.55(6*e*)	... ...	... ...
	c^2 ♂ *100xq*58.57.55(6*e*)	c^3 ♀ *100xq*58.58.55(6*e*)	c^4 ♀ *100xp*23.23.17(6*f*)	c^5 *– p – – – –*	... ...	... ...
	c^6 *– p – – – –*	... ...	... ...	... ...	... ...	... ...
5*H*35	a^1 ♂ *– p – – –*(5*b*)	a^2 ♀ *100xp*39.35.28(5*b*)	a^3 *– p – – – –*	a^4 *– p – – – –*	4*H*14b^1 ♂ *75 p*39.39.28(5*b*)	4*H*15b^4 ♀ *100xp*35.35.28(5*b*)
	a^6 *– p – – – –*	... ...	... ...	... ...	... ...	... ...
5*H*36	a^1 ♂ *100xp*37.37. 3(5*b*)	a^2 ♂ *100xp*35.35.30(5*b*)	a^3 ♀ *100xp*22.22.18(6*f*)	a^4 ♀ *100xp*35.35.28(5*b*)	4*H*14b^2 ♂ *100xp*39.35.28(5*b*)	4*H*22b^3 ♀ *75 p*39.39. 3(5*b*)
	a^5 ♂ *100xp*26.35. 6(5*b*)	a^6 *– p – – – –*	a^7 *– p – – – –*	b^1 ♂ *100xp*23.23.18(6*f*)	... ...	... ...
	b^2 ♂ *100xp*23.23.18(6*f*)	b^3 ♀ *100xp*23.23.18(6*f*)	b^4 ♀ *100xp*22.22.18(6*f*)	b^5 ♀ *100xp*39.35.28(5*b*)	... ...	... ...
	b^6 ♀ *75 p*39.39. 3(5*b*)	... ...	... ...	... ...	... ...	... ...
5*H*37	a^1 ♂ *100xp*35.35.28(5–6*b*)	a^2 ♀ *– p – – –*(5*b*)	a^3 ♀ *100xp*39.35.30(5*b*)	b^1 ♂ *100xp*23.23.22(6*f*)	4*H*16b^3 ♂ *100xp*39.39.28(5*b*)	4*H*15b^5 ♀ *– p – – –*(5*b*)
	b^2 ♂ *100xp*35.35. 6(5*b*)	b^3 ♀ *100xp*13.13.18(6*f*)	c^1 ♂ *100yp*18.18.18(5*b*)	c^2 ♂ *100xp*39.39.30(5*b*)	... ...	... ...
	c^3 ♂ *85 p*36.36. 3(5*b*)	c^4 ♀ *– p – – –*(5*b*)	... ...	... ...	... ...	... ...
5*H*40	a^1 ♂ *75 q*46.46. 2(5–6*c*)	a^2 ♀ *100xq*58.58.56(6*e*)	a^3 ♀ *100xq*58.58.55(6*e*)	a^4 ♀ *100xq* 48.46.14(5*c*)	4*H*15b^2 ♂ *– p – – –*(5*b*)	4*H*47a^5 ♀ *00 p – – –*(alb.)
	a^5 ♀ *– q – – –*(5*c*)	a^6 ♀ *00 p – – –*(alb.)	b^1 ♂ *100xq*58.58.55(6*e*)	b^2 ♂ *00 p – – –*(alb.)	... ...	... ...
	b^3 ♀ *100xq*58.58.55(5*e*)	b^4 ♀ *00 p – – –*(alb.)	c^1 ♂ *80 q*48.46.11(5*c*)	c^3 ♀ *00 p – – –*(alb.)	... ...	... ...
	c^3 ♀ *00 p – – –*(alb.)	... ...	... ...	... ...	... ...	... ...
5*H*44	a^1 ♂ *95 q*58.55. 4(4*e*)	a^2 ♂ *00 p – – –*(alb.)	a^3 ♂ *00 p – – –*(alb.)	a^4 ♂ *00 p – – –*(alb.)	*A*2b^1 ♂ *00 p – – –*(alb. *A*1)	4*H*17b^4 ♀ *100xp*23.23.18(6*f*)
	a^5 ♀ *100xq*58.58.57(6*e*)	a^6 ♀ *100xq*58.58.55(6*e*)	a^7 ♀ *00 p – – –*(alb.)	a^8 ♀ *00 p – – –*(alb.)	... ...	... ...
	b^1 ♂ *00 p – – –*(alb.)	b^2 ♂ *00 p – – –*(alb.)	b^3 ♀ *00 p – – –*(alb.)	b^4 ♀ *100xq*58.57.55(6*e*)	... ...	... ...
	c^1 ♂ *100xq*58.58.55(6*e*)	c^2 ♂ *100xq*58.58.55(6*e*)	c^3 ♂ *00 p – – –*(alb.)	c^4 ♀ *100xq*58.57.55(6*e*)	... ...	... ...
	c^5 ♀ *00 p – – –*(alb.)	c^6 ♀ *00 p – – –*(alb.)	... ...	... ...	... ...	... ...
5*H*45	a^1 ♂ *100xq*58.57.55(6*e*)	a^2 ♀ *100xq*58.57.55(6*e*)	a^3 ♀ *100xq*58.58.55(6*e*)	a^4 ♀ *100xq*57.57.56(6*e*)	*A*2b^1 ♂ *00 p – – –*(alb. *A*1)	4*H*48a^6 ♀ *– p – – –*(6*f*)
	a^5 ♀ *100xq*58.58.55(6*e*)	... ...	... ...	... ...	... ...	... ...
5*H*46	a^1 ♂ *75 q*48.46.11(5*c*)	a^2 ♂ *75 q*48.46.11(5*c*)	a^3 ♂ *100zq* 48.46.11(5*c*)	a^4 ♂ *100zq* 48.46.28(5*c*)	4*H*48a^1 ♂ *00 p – – –*(alb.)	4*H*69a^5 ♀ *80 p*39.39.28(5*b*)
	a^5 ♂ *– q – – –*(5*d*)	a^6 ♀ *100xq*58.58.55(6*e*)	a^7 ♀ *100xq*58.58.55(6*e*)	b^1 ♂ *100xq*58.58.55(6*e*)	... ...	... ...

	b^2 ♂ *80 q48.46. 2(5c)*	b^3 ♂ *75 q48.46. 2(5c)*	b^4 ♂ *100zq 48.46. 4(5c)*	b^5 ♂ *75 q48.46. 4(5c)*	... ...	... ...
	b^6 ♂ *75 q49.46. 4(5c)*	b^7 ♂ *60 q61.58. 1(3–4e)*	b^8 ♀ *100xq58.58.55(6e)*	c^1 ♂ *100xq58.57.55(6e)*	... ...	... ...
	c^2 ♂ *70 q61.55. 1(3e)*	c^3 ♀ *100xq58.58.55(6e)*	c^4 ♀ – *q* – – – (2–3e)	c^5 – *q* – – – –	... ...	... ...
5*H*47	a^1 ♂ *00 p* – – – (alb.)	a^2 ♀ *00 p* – – – (alb.)	a^3 ♀ *100xq58.58.57(6e)*	a^4 ♀ *85 q58.57. 2(4e)*	4*H*46a^1 ♂ *00 p* – – – (alb.)	4*H*16c^2 ♀ *100zp 40.40.31(5b)*
	a^5 ♀ – *q* – – – (5c)	a^6 – *q* – – – –	a^7 – *q* – – – –	a^8 – *p* – – – –	... ...	... ...
	a^9 – *p* – – – –	b^1 ♂ *00 p* – – – (alb.)	b^2 ♂ *00 p* – – – (alb.)	b^3 ♂ *00 p* – – – (alb.)	... ...	... ...
	b^4 ♂ *100zq 48.46.11(5c)*	b^5 ♀ *00 p* – – – (alb.)	b^6 ♀ *70 q48.46. 1(4c)*	b^7 – *q* – – – –	... ...	... ...
	b^8 – *p* – – – –	c^1 ♂ *00 p* – – – (alb.)	c^2 ♂ *00 p* – – – (alb.)	c^3 ♂ *00 p* – – – (alb.)	... ...	... ...
	c^4 ♂ *00 p* – – – (alb.)	c^5 ♀ *00 p* – – – (alb.)	c^6 ♀ *100xq58.58.57(6e)*	c^7 – *q* – – – –	... ...	... ...
5*H*50	a^1 ♀ *90 q48.46. 2(5c)*	a^2 ♀ *100zq 49.46.12(5c)*	a^3 ♀ *75 q49.46. 7(5c)*	a^4 ♀ *65 q48.46. 1(4c)*	4*H*16b^1 ♂ *100zp 39.39.30(5b)*	4*H*55a^6 ♀ *00 p* – – – (alb.)
	b^1 ♂ *75 q49.46.11(5c)*	b^2 ♂ *75 q49.46.11(5c)*	b^3 ♀ *90 q49.48. 1(4c)*	b^4 ♀ *65 q49.48. 1(3–4c)*	... ...	... ...
	b^5 ♂ – *q* – – – (5c)	c^1 ♂ *80 q49.46. 7(5c)*	c^2 ♀ – *q* – – – (3–4c)	c^3 – *q* – – – –	... ...	... ...
5*H*51	a^1 ♂ *85 p35.35. 3(5b)*	a^2 ♂ *00 p* – – – (alb.)	a^3 ♂ *00 p* – – – (alb.)	a^4 ♀ *80 q49.46.14(5c)*	4*H*36b^3 ♂ *00 p* – – – (alb.)	4*H*16c^3 ♀ *75 p39.39. 4(5b)*
	a^5 ♀ *100yp35.35. 3(5b)*	a^6 ♀ *00 p* – – – (alb.)	a^7 ♂ *00 p* – – – (alb.)	a^8 – *p* – – – –	... ...	... ...
	a^9 – *p* – – – –	b^1 – *q* – – – –	b^2 ♀ *00 p* – – – (alb.)	b^3 ♀ *00 p* – – – (alb.)	... ...	... ...
	b^4 ♀ *00 p* – – – (alb.)	... ...	... ...	... ...	... ...	... ...
5*H*52	a^1 ♀ *55 q48.46. 4(2–3c)*	a^2 ♀ *35 q49. 1. 1(2e)*	a^3 ♂ – *q* – – – (–e)	b^1 ♂ *50 q48.46. 1(3c)*	4*H*57b^2 ♂ *00 p* – – – (alb.)	4*H*69a^6 ♀ *75 p39.39.28(5b)*
	b^2 ♀ *100xq49.48.47(6c)*	b^3 ♀ *100yq49.48. 1(5c)*	b^4 ♀ *30 q48. 1. 2(2c)*	b^5 ♀ *50 q49.46. 1(3c)*	... ...	... ...
	b^6 ♀ *55 q49.46. 1(3c)*	c^1 ♂ *100yq48.46. 2(5c)*	c^2 ♂ *50 q48. 1. 1(3c)*	c^3 ♀ *100zq 48.46.12(5c)*	... ...	... ...
5*H*53	a^1 ♂ *100xq57.57.56(6e)*	a^2 ♂ *100xp15.15.15(6f)*	a^3 ♂ *100xp22.17.17(6f)*	a^4 ♂ *75 p36.35. 2(5b)*	4*H*22c^1 ♂ *75 p39.35. 2(5b)*	4*H*33c^5 ♀ *00 p* – – – (alb.)
	a^5 ♀ – *p* – – – (5b)	a^6 ♀ *100xp15.15.15(6f)*	a^7 ♀ *100xq58.58.55(6e)*	a^8 ♀ *100zq 48.46.43(5c)*	... ...	... ...
5*H*54	a^1 ♂ *100xp15.15.15(6f)*	a^2 ♂ *35 q61. 1. 1(2e)*	b^1 ♂ *100xq58.58.56(5e)*	b^2 ♂ *100xq58.57.56(5e)*	4*H*58b^1 ♂ *00 p* – – – (alb.)	4*H*69b^3 ♀ *100yp22.15.18(5f)*
	b^3 ♀ *60 q58. 1. 1(3e)*	b^4 ♀ *100xp10.10.10(6f)*	b^5 ♀ *100xp15.15.15(6f)*	c^1 ♀ *45 q61.61. 1(3e)*	... ...	... ...
	c^2 – *p* – – – –	... ...	... ...	... ...	... ...	... ...
5*H*55	a^1 ♂ *90 q57.56. 2(4e)*	a^2 ♂ *60 q57. 1. 1(3e)*	a^3 ♂ *75 q58. 1. 1(3e)*	a^4 ♂ *100yq58.57.55(4e)*	4*H*45a^1 ♂ *100xp23.23.17(6f)*	4*H*63a^7 ♀ *00 p* – – – (alb.)
	a^5 ♀ *80 q58.58. 2(4e)*	... ...	... ...	... ...	... ...	... ...
5*H*56	a^1 ♂ *100xq58.58.55(6e)*	b^1 ♂ – *q* – – – (6e)	b^2 ♂ *90 q57.57.55(4e)*	b^3 ♂ *80 q57.55. 1(4e)*	4*H*65b^6 ♂ *00 p* – – – (alb.)	4*H*41b^2 ♀ *100xp26.26.17(6f)*
	b^4 ♀ *100xq58.58.55(6e)*	b^5 ♀ *100xq58.57.55(6e)*	c^1 ♂ *80 q58.55. 2(4e)*	c^2 ♀ *100xq58.58.55(6e)*	... ...	... ...
	c^3 ♀ *95 q58.55. 1(5e)*	... ...	... ...	... ...	... ...	... ...
5*H*57	a^1 ♂ *100xq57.57.56(5e)*	a^2 ♂ – *q* – – – (3–4e)	a^3 ♀ *100xq58.57.55(6e)*	a^4 ♀ *100xq58.58.55(5e)*	4*H*66a^1 ♂ *100xq57.57.55(5e)*	4*H*52b^2 ♀ *100yq58.58.56(5e)*
	a^6 ♀ – *q* – – – (5e)	b^1 ♂ *100yq57.57.56(5e)*	b^2 ♂ *100xq58.57.55(5e)*	b^3 ♂ *100xq57.57.56(5e)*	... ...	... ...
	b^4 ♂ *75 q58.57. 4(4e)*	b^5 ♀ *100xq58.58.56(5e)*	b^6 – *q* – – – –	c^1 ♂ – *q* – – – (6e)	... ...	... ...
	c^2 ♂ *100xq58.57.55(6e)*	c^3 ♀ *100xq58.58.56(6e)*	c^4 ♀ *100xq58.58.55(6e)*	c^5 – *q* – – – –	... ...	... ...
5*H*58	a^1 ♂ – *q* – – – (6e)	a^2 ♂ *60 q58. 1. 1(3e)*	a^3 ♀ *00 p* – – – (alb.)	a^4 ♀ *100yq58.58.55(5e)*	4*H*66a^3 ♂ *100yq58.57.55(5e)*	4*H*49a^3 ♀ *100xq58.58.55(5e)*
	a^5 ♀ *100xq58.58.55(5e)*	... ...	... ...	... ...	... ...	... ...
5*H*59	a^1 ♂ *100xq58.57.56(6e)*	a^2 ♂ *100xq58.57.55(5e)*	a^3 ♂ *40 q58.58. 1(2e)*	a^4 ♀ – *q* – – – (6e)	4*H*52c^1 ♂ *100yq58.58.56(5e)*	4*H*51a^4 ♀ *100xq58.57.56(6e)*
	a^5 ♀ *100xq58.58.55(6e)*	a^6 ♀ *75 q58.55. 1(4e)*	a^7 ♀ *75 q58.57. 1(4e)*	b^1 ♂ *100xq57.57.56(6e)*	... ...	... ...
	b^2 ♂ *100xq58.58.56(6e)*	b^3 ♂ *65 q58. 1. 1(4e)*	b^4 ♂ – *q* – – – (3e)	b^5 ♀ *100xq58.58.55(6e)*	... ...	... ...
	b^6 ♀ *100xq58.58.57(5e)*	b^7 ♀ *100xq58.58.57(5e)*	c^1 ♂ *100xq58.58.55(5–6e)*	c^2 ♂ *100xq58.58.56(6e)*	... ...	... ...
	c^3 ♂ *100yq58.58.55(5e)*	c^4 ♀ *75 q58.55. 1(3e)*	c^5 ♀ *60 q58.58. 1(3e)*	c^6 ♀ *100xq58.57.55(5e)*	... ...	... ...
	c^7 ♀ *100xq58.57.55(6e)*	c^8 ♀ *100xq58.58.55(5e)*	... ...	... ...	... ...	... ...
5*H*60	a^1 ♂ *00 p* – – – (alb.)	a^2 ♂ *00 p* – – – (alb.)	a^3 ♂ *00 p* – – – (alb.)	a^4 ♂ *00 p* – – – (alb.)	4*H*63a^3 ♂ *00 p* – – – (alb.)	4*H*57b^3 ♀ *00 p* – – – (alb.)
	a^5 ♀ *00 p* – – – (alb.)	a^6 ♀ *00 p* – – – (alb.)	a^7 ♀ *00 p* – – – (alb.)	a^8 ♀ *00 p* – – – (alb.)	... ...	... ...
5*H*62	a^1 ♂ *100xq58.60.55(5–6e)*	a^2 ♂ *100yq60.60. 2(5e)*	a^3 ♂ *100xq58.60.55(5ew)*	a^4 ♀ *100xq58.57.55(6e)*	4*H*47c^1 ♂ *100xq58.57.55(6e)*	4*H*49c^3 ♀ *100xq57.57.55(6e)*
	a^5 ♀ *100xq58.60.55(5–6e)*	a^6 ♀ *100xq58.57.55(5–6e)*	a^7 – *p* – – – –	b^1 ♀ *100xq58.58.55(6e)*	... ...	... ...
	b^3 ♀ *100xq60.60.54(5–6e)*	... ...	... ...	... ...	... ...	... ...
5*H*63	a^1 ♂ *100xq58.58.55(6e)*	a^2 ♀ *100xq58.58.55(6ew)*	a^3 ♀ *100xq58.60.55(6ew)*	b^1 ♂ *100xq58.58.55.60(6e)*	4*H*46c^6 ♂ *100xq58.58.55(6e)*	4*H*51c^3 ♀ *100xq58.58.55(6e)*
	b^2 ♂ *100xq58.57.60(5ew)*	b^3 ♀ *100xq58.57.55(6e)*	b^4 ♀ *100xq58.58.55(6ew)*	... ...	... ...	... ...
5*H*64	a^1 ♀ *100xq58.58.55(6e)*	... ...	... ...	... ...	4*H*51b^4 ♂ *100xq58.58.55(6e)*	4*H*46c^5 ♀ *100xq57.57.55(5e)*
5*H*69	a^1 ♂ *100xq58.60.60(6e)*	a^2 ♀ *100xq58.60.60(6e)*	a^3 ♀ *100xq58.58.55(6e)*	a^4 ♀ *100xq58.57.55(6e)*	4*H*65b^4 ♂ *80 q58.55. 3(4e)*	4*H*49b^3 ♀ – *q* – – – (6e)

MATING	OFFSPRING				PARENTS	
					Father	Mother
5*H*72	a^1 ♂ *45 q*61. 1. 1(2*e*)	a^2 ♂ *65 q*42.50. 1(4*g*)	a^3 ♀ *70 q*58.57. 1(4*e*)	a^4 ♀ *70 q*58.57. 1(4*e*)	4*H*60c^3 ♂ *65 q*58.55. 1(3–4*e*)	4*H*56b^4 ♀ *80 q*58.55. 3(4*e*)
	a^5 ♀ *50 q*61.60. 1(3*e*)	a^6 ♀ *95 q*41.26. 1(4–5*g*)	a^7 ♀ *00 p* – – –(alb.)	b^1 ♂ *85 q*58.60. 1(4*e*)	... ...	... ...
	b^2 ♂ *65 q*61.60. 1(3–4*e*)	b^3 ♂ *00 p* – – –(alb.)	b^4 ♂ *00 p* – – –(alb.)	b^5 ♀ *85 q*58.55. 1(4*e*)	... ...	... ...
	b^6 ♀ *90 q*58.55. 3(4*e*)	b^7 ♀ *85 q*58.55. 1(4*e*)	b^8 ♀ *60 q*58.60. 1(3–4*e*)	b^9 ♀ *90 q*42.50. 1(4*g*)	... ...	... ...
5*H*73	a^1 ♂ *90 q*58.60. 2(4*e*)	a^2 ♂ *50 q*58.58. 1(3*e*)	a^3 ♀ *85 q*61.60. 1(4*e*)	a^4 ♀ *80 q*58.57. 1(4*e*)	4*H*59c^3 ♂ *60 q*58. 1. 1(4*e*)	4*H*56b^5 ♀ *90 q*58.55. 1(4*e*)
	a^5 ♀ *00 p* – – –(alb.)	b^1 ♂ *00 p* – – –(alb.)	... ...	... ...	... ...	... ...
5*H*76	a^1 ♂ *100zq* 49.48.43(5*c*)	a^2 ♂ *100zq* 49.46. 2(5*c*)	a^3 ♀ *100zq* 48.46.43(5–6*c*)	a^4 ♀ *100xq*60.60.55(5*e*)	4*H*48c^4 ♂ *00 p* – – –(alb.)	4*H*75b^3 ♀ *80 p*40.36.28(5*b*)
	a^5 ♀ *100xp*23.23.15(6*f*)	b^1 ♂ *100xq*58.60.60(6*e*)	b^2 ♂ *100yq*58.60.55(5*e*)	b^3 ♂ *100xq*58.57.55(5*e*)	... ...	... ...
	b^4 ♀ *100xq*58.57.60(5*e*)	b^5 ♀ *100zp*35.35. 3(5*b*)	c^1 ♂ *100xq*58.60.60(5–6*e*)	c^2 ♀ *100xq*60.60.60(5–6*e*)	... ...	... ...
	c^3 ♀ *100xq*58.60.55(5*e*)	... ...	... ...	... ...	... ...	... ...
5*H*77	a^1 ♂ *100xp*35.35.34(5*b*)	a^2 ♂ *100zp*36.33.28(5*b*)	a^3 ♂ *100zq* 48.46.14(5*c*)	a^4 ♀ *100zp*36.36. 2(5*b*)	4*H*48c^4 ♂ *00 p* – – –(alb.)	4*H*75b^4 ♀ *75 p*39.35.28(5*b*)
	b^1 ♀ *100zp* 36.36. 3(5*b*)	b^2 ♀ *100zq* 48.46.43(5*c*)	b^3 ♀ *100zq* 48.46.43(5*c*)	c^1 ♂ *100zq* 49.46.14(5*c*)	... ...	... ...
	c^2 ♂ *100zq* 49.46.43(5*c*)	... ...	... ...	... ...	... ...	... ...
5*H*78	a^1 ♂ *75 p*39.35. 1(5*b*)	a^2 ♂ *100zq* 48.46.11(5*c*)	a^3 ♀ *75 p*35.35. 4(5*b*)	a^4 ♀ *100zq* 49.46.43(5*c*)	4*H*48c^4 ♂ *00 p* – – –(alb.)	4*H*75b^5 ♀ *75 p*39.39. 4(5*b*)
	a^5 ♀ *100zq* 49.46.43(5*c*)	b^1 ♂ *80 p*36.36. 4(5*b*)	b^2 ♂ *75 p*34.34. 3(5*b*)	b^3 ♂ *100zq* 48.46.43(5*c*)	... ...	... ...
	b^4 ♀ *75 p*36.36. 4(5*b*)	b^5 ♀ *80 p*36.36. 3(5*b*)	b^6 ♀ *100zq* 49.46.43(5*c*)	b^7 ♀ *100zq* 49.46.43(5*c*)	... ...	... ...
5*H*81	a^1 ♂ *95 p*36.33. 3(5*b*)	a^2 ♂ *50 p*39. 1. 1(2–3*b*)	a^3 ♂ *35 p*37.37. 1(2*b*)	a^4 ♀ *30 p*39. 1. 1(2*b*)	4*H*69c^2 ♂ *100xp*39.39.31(6*b*)	4*H*75a^5 ♀ *100xp*39.35.30(5*b*)
	a^5 ♀ *40 p*39. 1. 1(2*b*)	b^1 ♂ *95 p*37.35.28(5*b*)	b^2 ♂ *35 p*37. 1. 1(2*b*)	b^3 ♂ *25 p*37. 1. 1(2*b*)	... ...	... ...
	b^4 ♀ *75 p*35.35. 3(5*b*)	b^5 ♀ *80 p*39.35. 3(5*b*)	b^6 ♀ *80 p*39.35. 3(5*b*)	c^1 ♂ *100zp* 36.35.28(5*b*)	... ...	... ...
	c^2 ♂ *100zp* 36.36. 6(5*b*)	c^3 ♂ *100zp* 39.36. 4(5*b*)	c^4 ♂ *95 p*39.35.30(5*b*)	c^5 ♀ *100zp*37.36. 3(5*b*)	... ...	... ...
5*H*82	a^1 ♂ *100zp* 39.35. 3(5*b*)	a^2 ♂ *100zp* 36.36. 9(5*b*)	a^3 ♂ *100zp* 35.35. 4(5*b*)	a^4 ♂ *100zp* 39.39.15(5–6*b*)	4*H*69c^3 ♂ *100zp*39.33.30(5*b*)	4*H*76a^6 ♀ *100zp*35.35.28(5*b*)
	a^5 ♀ *100xp*39.39.31(5–6*b*)	a^6 ♀ *100xp*39.39 31(5–6*b*)	a^7 ♀ *100xp*39.39.35(5*b*)	a^8 ♀ *100zp* 39.39.28(5*b*)	... ...	... ...
	b^1 ♂ *100zp* 39.35.28(5*b*)	b^2 ♀ *100zp*26.34.28(5*b*)	... ...	... ...	... ...	... ...
5*H*84	a^1 ♂ *100xp*26.26. 8(6*f*)	a^2 ♂ *100xp*26.26. 8(6*f*)	a^3 ♂ *100xp*19.23.18(6*f*)	a^4 ♀ *100xp*26.23.23(6*f*)	4*H*51c^1 ♂ *100xp*26.23.15(6*f*)	4*H*39b^3 ♀ *100xp*23.23.18(6*f*)
	a^5 ♀ *100xp*26.23.18(6*f*)	a^6 ♀ *100xp*23.23.10(6*f*)	b^1 ♂ *100xp*26.26.17(6*f*)	b^2 ♂ *100xp*23.23.15(6*f*)	... ...	... ...
	b^3 ♂ *100xp*23.23.15(6*f*)	b^4 ♀ *100xp*23.23.18(6*f*)	b^5 ♀ *100xp*23.23.15(6*f*)	c^1 ♂ *100xp*23.23.15(6*f*)	... ...	... ...
	c^2 ♂ *100xp*23.23.15(6*f*)	c^3 ♂ *100xp*22.22.18(6*f*)	c^4 ♀ *100xp*23.23.15(6*f*)	c^5 ♀ *100xp*23.23.15(6*f*)	... ...	... ...
5*H*85	a^1 ♂ *100xp*23.23.18(6*f*)	a^2 ♀ *100xp*23.23.15(6*f*)	a^3 ♀ *100xp*22.22.23(6*f*)	a^4 ♀ *100xp*22.22.18(6*f*)	4*H*38c^1 ♂ *100xp*22.22.15(6*f*)	4*H*45c^2 ♀ *100xp*15.15.15(6*f*)
5*H*87	a^1 ♂ *100xp*26.23.17(6*f*)	a^2 ♂ *100xp*23.23.15(6*f*)	a^3 ♀ *95 p*22.23. 1(5*f*)	a^4 ♀ *85 p*22.22. 1(4*f*)	4*H*48b^3 ♂ *100xp*22.22.18(6*f*)	4*H*51c^3 ♀ *100xp*23.23.18(6*f*)
	b^1 ♂ *100xp*23.23.15(6*f*)	b^2 ♂ *100xp*23.23.15(5*f*)	b^3 ♂ *85 p*26.23. 1(4–5*f*)	b^4 ♀ *100xp*26.23.15(6*f*)	... ...	... ...
	b^5 ♀ *100xp*23.15.15(6*f*)	b^6 ♀ *100xp*26.23.15(6*f*)	b^7 ♀ *80 p*26. 1. 1(4*f*)	c^1 ♀ *100xp*23.23.17(6*f*)	... ...	... ...
	c^2 ♀ *100xp*23.23.15(6*f*)	c^3 ♀ *100xp*23.23.10(6*f*)	c^4 ♀ *100xp*23.23.15(6*f*)	c^5 ♀ *100xp*26.26.23(6*f*)	... ...	... ...
6*H*1	a^1 ♂ *100xq*58.58.55(6*e*)	a^2 ♂ *100xq*58.58.55(6*e*)	a^3 ♂ *80 q*48.46.11(5*c*)	a^4 ♀ *100xq*58.58.55(6*e*)	5*H*40a^1 ♂ *75 q*46.46. 2(5–6*c*)	5*H*50a^1 ♀ *90 q*48.46. 2(5*c*)
	a^5 ♀ *100xq*58.58.55(6*e*)	a^6 ♀ *100zq* 48.46. 7(5*c*)	a^7 ♀ *100zq* 46.46.14(5*c*)	a^8 ♀ *00 p* – – –(alb.)	... ...	... ...
	b^1 ♂ *100zq* 48.46.43(6*d*)	b^2 ♂ *60 q*48.46. 4(4*c*)	b^3 ♂ *75 p*35.35. 2(5*b*)	b^4 ♂ *100zp* 36.36. 4(5*b*)	... ...	... ...
	b^5 ♂ *00 p* – – –(alb.)	b^6 ♂ *00 p* – – –(alb.)	b^7 – *q* – – – –	b^8 – *p* – – – –	... ...	... ...
	c^1 – *q* – – – –	c^2 – *q* – – – –	c^3 – *q* – – – –	c^4 – *q* – – – –	... ...	... ...
	c^5 – *p* – – – –	c^6 – *p* – – – –	c^7 – *p* – – – –	... ...	... ...	... ...
6*H*2	a^1 ♂ *100zq* 48.46.11(5*c*)	a^2 ♂ *100zq* 52.46.14(5*c*)	a^3 ♂ *100zq* 49.48. 7(5*c*)	a^4 ♀ *100xp*23.22.17(5*fw*)	5*H*46a^2 ♂ *75 q*48.46.11(5*c*)	5*H*50a^2 ♀ *100zq* 49.46.12(5*c*)
	a^5 ♀ *80 p*35.35. 4(5*b*)	a^6 ♀ *00 p* – – –(alb.)	a^7 – *q* – – – –	b^1 ♂ *100xq*58.57.55(6*e*)	... ...	... ...
	b^2 ♂ *100zq* 48.46. 7(5*c*)	b^3 ♂ *75 q*48.46. 4(5*c*)	b^4 ♂ *100zq* 48.46. 4(5*c*)	b^5 ♂ *00 p* – – –(alb.)	... ...	... ...
	b^6 ♀ *100zq* 52.46.14(5*c*)	b^7 ♀ *100zp*39.35.28(5*b*)	b^8 ♀ *100xq*58.57.55(5*e*)	c^1 ♂ *90 q*48.46.14(5*c*)	... ...	... ...
	c^2 ♂ *100zq* 48.46.11(5*c*)	c^3 ♂ *100zq* 52.46. 7(5*c*)	c^4 ♂ *80 p*36.35. 3(5*b*)	c^5 ♀ *80 p*35.35. 3(5*b*)	... ...	... ...

	c^6 ♀ *75 p*36.35. 3(5*b*)	c^7 ♀ *100zq* 52.46.14(5*c*)	c^8 ♀ *00 p* – – –(alb.)	… … …	… … … …	… … … …
6*H*3	a^1 ♂ *100xp* 36.36.30(5*b*)	a^2 ♂ *100xq* 58.60.55(6*e*)	a^3 ♂ *100xq* 58.58.55(6*e*)	a^4 ♂ *100zq* 48.46.14(5*c*)	5*H*46a^3 ♂ *100zq* 48.46.11(5*c*)	5*H*51a^4 ♀ *80 q*49.46.14(5*c*)
	a^5 ♂ *100xp* 17.17.15(6*f*)	a^6 ♂ *100zq* 48.46.11(5*c*)	a^7 ♀ *100zq* 52.46. 4(5*c*)	a^8 ♀ *100xq* 58.58.55(6*e*)	… … … …	… … … …
	b^1 ♂ *100zq* 49.46.43(5*c*)	b^2 ♀ *100xq* 57.57.56(6*e*)	b^3 ♀ *100xq* 58.57 56(6*e*)	b^4 ♀ *75 q*48.48. 2(5*c*)	… … … …	… … … …
	b^5 ♀ *100zq* 49.46.14(5*c*)	b^6 ♀ *100zq* 48.46.11(5*c*)	c^1 ♂ *80 q*48.46. 4(5*c*)	c^2 ♂ *100zp* 39.35. 4(5*b*)	… … … …	… … … …
	c^3 ♂ *00 p* – – –(alb.)	c^4 ♀ *00 p* – – –(alb.)	c^5 ♀ *00 p* – – –(alb.)	c^6 ♀ *100zq* 48.46.43(5*c*)	… … … …	… … … …
6*H*4	a^1 ♂ *100zp* 39.39. 3(5*bw*)	a^2 ♂ *100xp* 23.23.15(6*f*)	a^3 ♂ *75 p*36.36. 3(5*b*)	a^4 ♀ *80 q*48.48. 4(5*c*)	5*H*46a^4 ♂ *100zq* 48.46.28(5*c*)	5*H*53a^8 ♀ *100zq* 48.46.43(5*c*)
	a^5 ♀ *100zp* 39.39.28(5*bw*)	a^6 ♀ *75 p*35.35. 3(5*b*)	a^7 ♀ – *p* – – –(5*b*)	a^8 ♀ *00 p* – – –(alb.*w*)	… … … …	… … … …
	a^9 – *q* – – –	a^{10} – *p* – – –	b^1 ♂ *00 p* – – –(alb.)	b^2 ♂ *00 p* – – –(alb.)	… … … …	… … … …
	b^3 ♀ *100zq* 48.46.11(5*cw*)	b^4 ♀ *00 p* – – –(alb.)	b^5 ♀ *00 p* – – –(alb.)	… … …	… … … …	… … … …
6*H*5	a^1 ♂ *100xp* 26.26.23(6*f*)	a^2 ♂ *100xp* 36.36.30(6*b*)	a^3 ♂ *80 p*36.35. 3(5*b*)	a^4 ♂ *100zq* 52.46.43(5*c*)	5*H*47b^4 ♂ *100zq* 48.46.11(5*c*)	5*H*52b^2 ♀ *100xq* 49.48.47(6*c*)
	a^5 ♂ *00 p* – – –(alb.)	a^6 ♀ *100xq* 49.48.47(6*c*)	a^7 – *q* – – –	b^1 ♂ *100zp* 39.36. 3(5*b*)	… … … …	… … … …
	b^2 ♂ *85 p*36.34. 3(5*b*)	b^5 ♂ *100xq* 49.46.47(6*c*)	b^4 ♂ *00 p* – – –(alb.)	b^5 ♀ *100xq* 48.46.46(6*c*)	… … … …	… … … …
	b^6 ♀ *100zq* 48.46.43(5*c*)	b^7 ♀ *00 p* – – –(alb.)	c^1 ♂ *100xq* 58.58.55(6*e*)	c^2 ♂ *85 p*34.34. 3(5*b*)	… … … …	… … … …
	c^3 ♂ *100zq* 46.46.43(5*c*)	c^4 ♀ *80 p*36.35. 3(5*b*)	c^5 ♀ *100zq* 48.46.11(5*c*)	… … …	… … … …	… … … …
6*H*6	a^1 ♂ *75 q*46.46.11(5*c*)	a^2 – *p* – – –	… … …	… … …	5*H*50b^1 ♂ *75 q*49.46.11(5*c*)	5*H*52b^3 ♀ *100yq* 49.48. 1(5*e*)
6*H*7	a^1 ♂ *100xp* 26.23.18(6*f*)	a^2 ♂ *65 q*49.46. 3(4*c*)	a^3 ♂ *00 p* – – –(alb.)	b^1 ♂ *100zp* 35.35. 2(5*b*)	5*H*50b^2 ♂ *75 q*49.46.11(5*c*)	5*H*47b^6 ♀ *70 q*48.46. 1(4*c*)
	b^2 ♂ *100zq* 52.46.43(5*c*)	b^3 ♂ *00 p* – – –(alb.)	b^4 ♂ *00 p* – – –(alb.)	b^5 ♀ *100xq* 58.58.55(6*e*)	… … … …	… … … …
	b^6 ♀ *100xq* 58.57.55(5*e*)	b^7 ♀ *00 p* – – –(alb.)	c^1 ♂ *100zq* 48.46. 4(5*c*)	c^2 ♂ *100zq* 48.46. 7(5*c*)	… … … …	… … … …
	c^3 ♂ *100zp* 39.35.30(5*b*)	c^4 ♂ *00 p* – – –(alb.)	c^5 ♀ *45*·*q*49.46. 1(3*c*)	c^6 ♀ *40 q*49.46. 1(3*c*)	… … … …	… … … …
	c^7 – *p* – – –	… … …	… … …	… … …	… … … …	… … … …
6*H*8	a^1 ♀ *00 p* – – –(alb.)	a^2 ♀ *00 p* – – –(alb.)	… … …	… … …	5*H*46b^6 ♂ *75 q*49.46. 4(5*c*)	5*H*50b^3 ♀ *90 q*49.48. 1(4*c*)
6*H*10	a^1 ♂ *100zq* 48.46. 7(5*c*)	a^2 ♂ *55 q*48.46. 1(3*c*)	a^3 ♀ *80 q*58.55. 1(3*e*)	a^4 ♀ *25 p*23. 1. 1(1*f*)	5*H*46b^3 ♂ *75 q*48.46. 2(5*c*)	5*H*52b^5 ♀ *50 q*49.46. 1(3*c*)
	a^5 ♀ *35 q*49. 1. 1(2*c*)	a^6 ♀ *00 p* – – –(alb.)	b^1 ♂ *75 p*36.35. 3(5*b*)	b^2 ♂ *60 p*37. 1. 1(3*b*)	… … … …	… … … …
	b^3 ♀ *100zq* 49.48.43(5*c*)	b^4 ♀ *100zq* 49.46.43(4*c*)	b^5 ♀ *100zp* 36.35. 3(5*b*)	b^6 ♀ *35 q*48. 1. 1(2*c*)	… … … …	… … … …
	c^1 ♂ *85 q*48.46. 3(4*c*)	c^3 ♀ *100zq* 48.46.43(5*c*)	c^3 ♀ *50 p*37.35. 1(2*b*)	c^4 ♀ *45 p*37. 1. 3(2*b*)	… … … …	… … … …
	c^5 ♀ *00 p* – – –(alb.)	c^6 ♀ *00 p* – – –(alb.)	c^7 ♀ *00 p* – – –(alb.)	… … …	… … … …	… … … …
6*H*11	a^1 ♂ *100zq* 48.48.28(5*c*)	a^2 ♂ *100zq* 48.48. 2(5*c*)	a^3 ♂ *50 q*48.35. 3(3*c*)	a^4 ♂ *00 p* – – –(alb.)	5*H*46b^4 ♂ *100zq* 48.46. 4(5*c*)	5*H*52b^6 ♀ *55 q*49.46. 1(3*c*)
	a^5 ♀ *55 p*37.39. 4(3*b*)	a^6 ♀ *00 p* – – –(alb.)	a^7 – *q* – – –	b^1 ♂ *100zq* 48.46. 7(5*c*)	… … … …	… … … …
	b^2 ♂ *100xp* 23.23.18(6*f*)	b^3 ♂ *85 q*48.46.33(4*c*)	b^4 ♀ *00 p* – – –(alb.)	… … …	… … … …	… … … …
6*H*12	a^1 ♀ *100zq* 48.46.14(5*c*)	a^2 ♀ *00 p* – – –(alb.)	b^1 ♂ *100zq* 49.46.43(5*c*)	b^2 ♂ *100zq* 49.46. 4(5*c*)	5*H*46b^5 ♂ *75 q*48.46. 4(5*c*)	5*H*52b^4 ♀ *30 q*48. 1. 2(2*c*)
	b^3 ♀ *100zq* 48.48.11(5*c*)	b^4 ♀ *100zq* 48.46.14(5*c*)	c^1 ♂ *90 p*23. 1.15(4*f*)	c^2 ♂ *100zp* 36.36. 3(5*b*)	… … … …	… … … …
	c^3 ♂ *00 p* – – –(alb.)	c^4 ♂ *00 p* – – –(alb.)	… … …	… … …	… … … …	… … … …
6*H*13	a^1 ♂ *100xq* 58.58.55(6*e*)	a^2 ♂ *100zp* 35.35. 3(5*b*)	b^1 ♂ *50 q*48. 1. 1(2–3*c*)	b^2 ♂ *00 p* – – –(alb.)	5*H*40c^1 ♂ *80 q*48.46.11(5*c*)	5*H*50c^2 ♀ – *q* – – –(3–4*c*)
	b^3 ♂ *00 p* – – –(alb.)	b^4 ♀ *100xp* 23.17.17(6*f*)	b^5 ♀ *90 p*26.26. 3(5*f*)	b^6 ♀ *90 q*48.35.28(4*c*)	… … … …	… … … …
	b^7 ♀ *00 p* – – –(alb.)	c^1 ♂ *80 q*48.46. 3(4*c*)	c^2 ♂ *100zp* 36.36. 3(5*b*)	c^3 ♂ *00 p* – – –(alb.)	… … … …	… … … …
	c^4 ♂ *00 p* – – –(alb.)	c^5 ♀ *75 q*48.46. 7(4*c*)	c^6 ♀ *70 q*49.48. 3(4*c*)	c^7 ♀ *60 q*48.46. 2(3*c*)	… … … …	… … … …
	c^8 ♀ *00 p* – – –(alb.)	c^9 ♀ *00 p* – – –(alb.)	… … …	… … …	… … … …	… … … …
6*H*14	a^1 ♂ *100zp* 39.35. 3(5*b*)	a^2 ♂ *00 p* – – –(alb.)	a^3 ♀ *100zq* 49.48.20(5*c*)	a^4 ♀ *100zq* 48.48.12(5*c*)	5*H*50c^1 ♂ *80 q*49.46. 7(5*c*)	5*H*52c^3 ♀ *100zq* 48.46.12(5*c*)
	a^5 ♀ *100xp* 22.22.17(6*f*)	a^6 ♀ *00 p* – – –(alb.)	a^7 – *q* – – –	b^1 ♂ *50 p*37. 1. 1(2*b*)	… … … …	… … … …
	b^2 ♀ *100zp* 39.39.30(5*b*)	c^1 ♂ *100xp* 23.23.15(6*f*)	c^2 ♂ *00 p* – – –(alb.)	c^3 ♂ *00 p* – – –(alb.)	… … … …	… … … …
	c^4 ♀ *100zq* 52.48.11(5*c*)	c^5 ♀ *100zq* 48.46.14(5*c*)	c^6 ♀ *60 q*48.46. 4(4*c*)	… … …	… … … …	… … … …
6*H*15	a^1 ♂ *100xq* 58.60.55(6*e*)	a^2 ♂ *100xq* 58.60.55(6*e*)	a^3 ♂ *100xq* 57.57.55(6*e*)	a^4 ♀ *100xq* 58.60.55(6*e*)	5*H*57c^2 ♂ *100xq* 58.57.55(6*e*)	5*H*59c^7 ♀ *100xq* 58.57.55(6*e*)
	a^5 ♀ *100xq* 58.58.55(6*e*)	a^6 ♀ *100xq* 58.58.57(5*e*)	b^1 ♂ *100xq* 58.60.55(6*e*)	b^2 ♂ *100xq* 58.58.55(6*e*)	… … … …	… … … …
	b^3 ♂ *100xq* 58.58.55(5*e*)	b^4 ♀ *100xq* 58.58.55(6*e*)	c^1 ♂ *100xq* 58.58.55(6*e*)	c^2 ♀ *100xq* 58.57.55(6*e*)	… … … …	… … … …
	c^3 ♀ *100xq* 58.58.55(6*e*)	c^4 ♀ *100xq* 58.55.55(6*e*)	c^5 ♀ *100xq* 58.58.57(5–6*e*)	… … …	… … … …	… … … …
6*H*16	a^1 ♂ *100xq* 58.58.55(6*e*)	a^2 ♂ *100xq* 58.57.55(5*e*)	a^3 ♂ *00 p* – – –(alb.)	a^4 ♂ *00 p* – – –(alb.)	5*H*32c^1 ♂ *100xq* 58.57.55(6*e*)	5*H*34c^3 ♀ *100xq* 58.58.55(6*e*)
	a^5 ♂ *00 p* – – –(alb.)	a^6 ♀ *100xq* 57.57.55(6*e*)	a^7 ♀ *100xq* 58.57.55(6*e*)	… … …	… … … …	… … … …
6*H*17	a^1 ♂ *100xq* 58.55.55(6*e*)	a^3 ♂ – *q* – – –(6*e*)	a^3 ♂ *100xq* 60.57.55(6*e*)	a^4 ♀ *100xq* 58.60.55(6*e*)	5*H*34c^1 ♂ *100xq* 58.58.55(6*e*)	5*H*32c^2 ♀ *100xq* 58.58.56(6*e*)
	a^5 – *q* – – –	b^1 ♂ *100xq* 58.58.45(6*e*)	b^2 ♂ *100xq* 58.57.55(6*e*)	b^3 ♂ *100yq* 58.55. 1(5*ew*)	… … … …	… … … …

MATING	OFFSPRING				PARENTS	
					Father	Mother
6*H*17	b^4 ♀ *100xq*58.58.55(6*e*)	b^5 ♀ *100xq*58.57.55(6*e*)	b^6 ♀ *100xq*58.55.55(6*e*)	b^7 ♀ *100xq*58.58.55(5*e*)	... ...	... ...
	c^1 ♂ *100xq*58.60.55(6*e*)	c^2 ♂ *100xq*60.57.55(5–6*e*)	c^3 ♂ *100yq*58.55.45(5*e*)	c^4 ♂ *100yq*58.58.55(5*e*)	... ...	... ...
	c^5 ♀ *100xq*58.55.55(6*e*)	c^6 ♀ *100xq*58.58.55(5–6*e*)	c^7 ♀ *100xq*58.60.55(5*e*)	... ...	... ...	... ...
6*H*18	a^1 ♂ *100xq*58.57.55(6*e*)	a^2 ♂ *100xp*22.22.15(6*f*)	a^3 ♀ *100xq*58.57.55(6*e*)	a^4 ♀ *100xq*58.58.55(6*e*)	5*H*29c^1 ♂ *100xq*58.58.55(6*e*)	5*H*30c^3 ♀ *100xq*58.56.55(6*e*)
	a^5 ♀ *100xq*58.58.55(6*e*)	a^6 ♀ *100xq*58.57.55(5–6*e*)	a^7 ♀ *100xp*23.23.15(6*f*)	a^8 ♀ *100xp*23.23.15(6*f*)	... ...	... ...
	b^1 ♂ *100xq*58.57.55(6*e*)	b^2 ♂ *100xq*58.60.55(6*e*)	b^3 ♀ *100xq*58.60.55(6*e*)	b^4 ♀ *100xq*58.58.55(6*e*)	... ...	... ...
	b^5 ♀ *100xq*58.58.55(6*e*)	b^6 ♀ *100xq*58.58.55(6*e*)	b^7 ♀ *100xp*17.15.15(6*f*)	c^1 ♂ *100xq*58.58.55(6*e*)	... ...	... ...
	c^2 ♂ *100xq*58.60.55(5–6*e*)	c^3 ♂ *100xp*23.23.15(6*f*)	c^4 ♀ *100xq*60.60.55(6*e*)	c^5 ♀ *100xq*58.58.55(6*e*)	... ...	... ...
	c^6 ♀ *100xq*58.57.55(6*e*)	c^7 ♀ *100xq*58.58.55(6*e*)	c^8 ♀ *100xq*58.57.55(6*e*)	c^9 – *p* – – –	... ...	... ...
6*H*19	a^1 ♂ *100xq*58.58.55(6*e*)	a^2 ♀ *100xq*58.57.55(6*e*)	a^3 ♀ *100xp*26.26.23(6*f*)	b^1 ♂ *100xq*57.57.55(6*e*)	5*H*31c^4 ♂ *100xq*58.58.55(6*e*)	5*H*29c^3 ♀ *100xq*58.58.56(6*e*)
	b^2 ♂ *100xq*58.58.55(6*e*)	b^3 ♀ *100xq*58.58.55(6*e*)	b^4 ♀ *100xq*58.60.55(6*e*)	c^1 ♂ *100xp*22.23.15(6*f*)	... ...	... ...
	c^2 ♀ *100xq*58.60.55(6*e*)	c^3 ♀ *100xq*58.58.55(6*e*)	c^4 ♀ *100xq*57.57.55(6*e*)	c^5 ♀ *100xq*57.55.55(6*e*)	... ...	... ...
	c^8 ♀ *100xq*57.55.55(6*e*)	c^7 ♀ *100xq*58.57.55(6*e*)	c^8 – *q* – – –	c^9 – *q* – – –	... ...	... ...
	c^{10} – *p* – – –	... ...	... ...	... ...	... ...	... ...
6*H*20	a^1 ♂ *85 q*58.55. 4(4*e*)	a^2 ♂ – *q* – – –(4*e*)	a^3 ♂ *90 q*56.55. 2(3*e*)	a^4 ♂ – *q* – – –(4*e*)	5*H*27c^1 ♂ *85 q*58.44. 1(4*e*)	5*H*26c^4 ♀ *90 q*58.55. 2(4*e*)
	a^5 ♀ *90 q*58.55. 2(4–5*e*)	a^6 – *q* – – –	a^7 – *q* – – –	... ...	... ...	... ...
6*H*21	a^1 ♀ *95 q*58.58. 2(4*e*)	a^2 ♀ *85 q*58.60. 1(4*e*)	... ...	... ...	5*H*26c^1 ♂ *90 q*58.57. 1(5*e*)	5*H*27c^6 ♀ *75 q*58.56. 1(4*e*)
6*H*22	a^1 ♂ *100xq*56.58.55(6*e*)	a^2 ♂ – *q* – – –(5*e*)	a^3 ♀ *100xq*57.55.55(6*e*)	a^4 ♀ *100xq*57.57.55(6*e*)	5*H*33b^3 ♂ *100xq*58.57.55(6*e*)	5*H*58a^4 ♀ *100yq*58.58.55(5*e*)
	a^5 ♀ *80 q*58.55. 1(4*e*)	a^6 ♀ *00 p* – – –(alb.)	b^1 ♂ *100xq*57.57.55(6*e*)	b^2 ♂ *100xq*58.57.55(6*e*)	... ...	... ...
	b^3 ♂ *100yq*56.55. 1(5*e*)	b^4 ♀ *100xq*58.57.55(6*e*)	b^5 ♀ *100xq*58.57.55(6*e*)	b^6 ♀ *100xq*58.58.55(6*e*)	... ...	... ...
	b^7 ♀ *00 p* – – –(alb.)	c^1 ♀ *100xq*58.58.55(6*e*)	c^2 ♀ *100xq*58.58.55(6*e*)	c^3 ♀ *100xq*58.58.55(6*e*)	... ...	... ...
	c^4 ♀ *95 q*58.57. 2(4–5*e*)	... ...	... ...	... ...	... ...	... ...
6*H*23	a^1 ♂ *100xq*58.58.55(6*e*)	a^2 ♀ *100xq*58.58.55(6*e*)	a^3 ♀ *100xq*58.58.55(6*e*)	a^4 ♀ *100xq*58.55.55(5*e*)	5*H*58a^2 ♂ *60 q*58. 1. 1(3*e*)	5*H*33b^5 ♀ *100xq*58.57.56(6*e*)
	a^5 ♀ *100yq*58.58.55(5*ew*)	b^1 ♂ *100xq*58.60.55(6*e*)	b^2 ♂ *100xq*57.57.55(6*e*)	b^3 ♀ *100xq*58.60.55(6*e*)	... ...	... ...
	b^4 ♀ *100xq*58.55.55(5–6*e*)	b^5 ♀ *100xq*58.60.55(5*e*)	... ...	... ...	... ...	... ...
6*H*24	a^1 ♀ *100zp*37.35.30(5*b*)	a^2 ♀ *100zq* 52.46.14(5*c*)	b^1 ♂ *100zp*36.34. 3(5*b*)	b^2 ♂ *100zq*48.46.43(5*c*)	5*H*33b^3 ♂ *100xq*58.58.55(6*e*)	5*H*35a^2 ♀ *100zp*39.35.28(5*b*)
	b^3 ♂ *100zq* 48.46.43(5*c*)	b^4 ♂ *100zq* 48.46. 4(5*c*)	b^5 ♂ *100zq* 48.46. 7(5*c*)	b^6 ♀ *100zp*36.36. 4(5*b*)	... ...	... ...
	b^7 ♀ *100zq* 48.46.11(5*c*)	... ...	... ...	... ...	... ...	... ...
6*H*25	a^1 ♂ *100xq* 58.60.55(5–6*e*)	a^2 ♂ *100xq*58.57.56(5*e*)	a^3 ♂ *100zq* 52.46.12(5*c*)	a^4 ♂ *100zq* 49.46.14(5*c*)	5*H*31b^5 ♂ *100xq*58.58.55(5*e*)	5*H*37a^2 ♀ – *p* – – –(5*b*)
	a^5 ♀ *95 q*58.60. 4(5*e*)	a^6 ♀ *100zq* 48.46. 2(5*c*)	a^7 ♀ *100zq* 48.46.43(5*c*)	a^8 – *q* – – –	... ...	... ...
	a^9 – *q* – – –	b^1 ♂ *100zq* 44.47.11(5*c*)	b^2 ♂ *100zq* 48.46. 7(5*c*)	... ...	... ...	... ...
6*H*26	a^1 ♂ *100zp* 36.35. 3(5*b*)	a^2 ♂ *100zq* 52.46.14(5*c*)	a^3 ♂ *100zq* 48.46. 7(5*c*)	a^4 ♂ *55 q*49.46. 3(3*c*)	5*H*29c^4 ♂ *100xq*58.58.55(6*e*)	5*H*37a^3 ♀ *100zp*39.35.30(5*b*)
	a^5 ♀ *75 p*34.36. 3(5*b*)	a^6 ♀ *100zq* 48.46.43(5*c*)	b^1 ♀ *100zp*39.35. 3(5*b*)	b^2 ♀ *50 p*39.39. 1(2–3*b*)	... ...	... ...
	b^3 ♀ *100zq* 48.46. 7(5*c*)	b^4 ♀ *100zq* 48.46.11(5*c*)	b^5 ♀ *100zq* 48.46. 4(5*c*)	c^1 ♀ *60 q*48.47. 1(3*c*)	... ...	... ...
	c^2 ♀ *100zp* 26.37. 4(5*b*)	c^3 – *q* – – –	... ...	... ...	... ...	... ...
6*H*27	a^1 ♂ *100xp*22.22.18(6*f*)	a^2 ♂ *100xp*22.15.18(6*f*)	a^3 ♀ *100xp*22.22.17(6*f*)	a^4 ♀ *100xp*22.15.17(6*f*)	5*H*36b^3 ♂ *100xp*23.23.18(6*f*)	5*H*37b^3 ♀ *100xp*13.13.18(6*f*)
	a^5 ♀ *100xp*22.22.17(6*f*)	b^1 ♂ *100xp*26.26.17(6*f*)	b^2 ♂ *100xp*22.15.15(6*f*)	b^3 ♀ *100xp*23.23.18(6*f*)	... ...	... ...
	b^4 ♀ *100xp*23.23.17(6*f*)	... ...	... ...	... ...	... ...	... ...
6*H*28	a^1 ♂ *100xp*23.23.10(6*f*)	a^2 ♂ *100xp*26.15.15(6*f*)	a^3 ♀ *100xp*26.26.23(6*f*)	a^4 ♀ *100xp*23.23.15(6*f*)	5*H*33b^1 ♂ *100xp*23.15.18(6*f*)	5*H*31b^8 ♀ *100xp*22.22.18(6*f*)
	b^1 ♂ *100xp*23.23.18(6*f*)	b^2 ♂ *100xp*26.26.15(6*f*)	b^3 ♂ *100xp*26.26.23(5–6*f*)	b^4 ♀ *100xp*23.23.15(6*f*)	... ...	... ...
	b^5 ♀ *100xp*26.26.23(6*f*)	b^6 ♀ – *p* – – –(6*f*)	c^1 ♂ *100xp*26.23.15(6*f*)	c^2 ♂ *100xp*26.23.15(6*f*)	... ...	... ...
	c^3 ♀ *100xp*23.23.15(6*f*)	c^4 ♀ *100xp*23.23.15(6*f*)	c^5 ♀ *100xp*23.23.15(5*f*)	c^6 *100x* 23.23.15 –	... ...	... ...
6*H*29	a^1 ♂ *100xp*22.23.18(6*f*)	a^2 ♂ *100xp*19.19. 6(6*f*)	a^3 ♂ *100xp*23.23.15(6*f*)	a^4 ♀ *100xp*26.26.15(6*f*)	5*H*30c^1 ♂ *100xp*15.15.15(6*f*)	5*H*31a^7 ♀ *100xp*23.23.18(6*f*)
	a^5 ♀ *100xp*26.23.18(6*f*)	a^6 – *p* – – – –	b^1 ♂ *100xp*23.15.10(6*f*)	b^2 ♀ *100xp*26.23.15(6*f*)	... ...	... ...
	b^3 – *p* – – – –	b^4 – *p* – – – –	b^5 – *p* – – – –	b^6 – *p* – – – –	... ...	... ...

6*H*30	a^1 ♀ *100xp*22.22.23(6*f*)	a^2 ♀ *100xp*50.26.23(6*f*)	b^1 ♀ *100xp*26.26.23(6*f*)	b^2 ♀ *100xp*26.22.17(6*f*)	5*H*31a^2 ♂ *100xp*23.23.18(6*f*)	5*H*30a^3 ♀ *100xp*23.23.18(6*f*)
	b^3 ♀ *100xp*22.15.15(6*f*)	c^1 ♂ *100xp*24.24.24(6*f*)	c^2 ♂ *100xp*26.26.23(6*f*)	c^3 ♂ *100xp*26.26.23(6*f*)	... ...	... ...
	c^4 ♀ *100xp*50.50.26(6*f*)	c^5 ♀ *100xp*22.15.15(6*f*)	c^6 ♀ *100xp*26.23.15(6*f*)	... ...	... ...	... ...
6*H*31	a^1 ♂ *50 q44. 1. 1(3ch)*	a^2 ♂ *55 q44.54. 4(3ch)*	a^3 ♂ *55 q55. 1. 3(3ch)*	a^4 ♀ *45 q58.58. 1(3ch)*	5*H*27c^2 ♂ *35 q44. 1. 1(3ch)*	5*H*27b^5 ♀ *80 q57.57. 1(4ch)*
	a^5 ♀ *60 q58.44. 4(3ch)*	b^1 ♂ *55 q44.54. 1(3ch)*	b^2 ♂ *60 q44.43. 2(3ch)*	b^3 ♂ *55 q45.54. 1(3ch)*	... ...	... ...
	b^4 ♂ *60 q50.26. 2(4g–ch)*	b^5 ♀ *85 q26.26. 4(4g–ch)*	... ...	... ...	... ...	... ...
6*H*32	a^1 ♂ *55 q44.44. 1(3ch)*	a^2 ♀ *40 q58.44. 1(2ch)*	... ...	... ...	5*H*27c^3 ♂ *40 q52. 1. 1(3ch)*	5*H*27b^6 ♀ – *q* – – –(4*ch*)
6*H*33	a^1 ♂ – *p* – – –(6*f*)	a^3 ♂ *100xp* 44.44. 1(5*b*)	a^3 ♀ *100xp*15.15.18(6*f*)	a^4 ♀ *100xp*22.22.17(6*f*)	5*H*53a^4 ♂ *75 p*36.35. 2(5*b*)	5*H*51a^5 ♀ *100yp*35.35. 3(5*b*)
	a^6 ♀ *75 p*36.35. 4(5*b*)	... ...	... ...	... ...	... ...	... ...
6*H*34	a^1 ♂ *100xp*17.17.17(6*f*)	a^2 ♂ *100xp*22.17.17(6*f*)	a^3 ♂ *00 p* – – –(alb.)	a^4 ♂ *00 p* – – –(alb.)	5*H*51a^1 ♂ *85 p*35.35. 3(5*b*)	5*H*53a^6 ♀ *100xp*15.15.15(6*f*)
	a^5 ♀ *100xp*15.15.15(6*f*)	a^6 ♀ *75 p*36.35. 3(5*b*)	b^1 ♂ *100xp*36.36.30(5*b*)	b^2 ♀ *100xp*22.22.15(6*f*)	... ...	... ...
	b^3 ♀ *100xp*36.35.30(5*b*)	b^4 ♀ *100xp* 36.33. 3(5*b*)	b^5 ♀ *100xp*35.34. 3(5*b*)	b^6 ♀ *00 p* – – –(alb.)	... ...	... ...
	b^7 – *p* – – –	... ...	... ...	... ...	... ...	... ...
6*H*35	a^1 ♂ *100xp*22.10.10(6*f*)	a^2 ♂ *00 p* – – –(alb.)	a^3 ♀ *100xp*15.15.10(6*f*)	a^4 ♀ *100xp*15.15.15(6*f*)	5*H*53a^2 ♂ *100xp*15.15.15(6*f*)	5*H*54b^4 ♀ *100xp*10.10.10(6*f*)
	a^6 ♀ *100xp*15.15.10(6*f*)	a^6 ♀ *00 p* – – –(alb.)	a^7 – *p* – – –	... ...	... ...	... ...
6*H*36	a^1 ♂ *100xp*22.22.15(6*f*)	a^2 ♂ *100xp*15.15.15(6*f*)	a^3 ♂ *100xp*17.17.15(6*f*)	a^4 ♂ *100xp*15.15.15(6*f*)	5*H*53a^3 ♂ *100xp*22.17.17(6*f*)	5*H*54b^5 ♀ *100xp*15.15.15(6*f*)
	a^5 ♂ *100xp*22.22.15(5*f*)	a^6 ♀ *100xp*15.15.15(6*f*)	a^7 ♀ *100xp*23.23.15(5*f*)	b^1 ♂ – *p* – – –(6*f*)	... ...	... ...
	b^2 ♂ *100xp*15.15.15(6*f*)	b^3 ♂ *100xp*23.23.18(5*f*)	b^4 ♀ *100xp*15.15.10(6*f*)	b^5 ♀ *100xp*23.23.15(6*f*)	... ...	... ...
	b^6 ♀ *100xp*23.23.17(6*f*)	b^7 ♀ *100xp*17.17.15(6*f*)	b^8 ♀ *100xp*15.15.15(5*f*)	b^9 ♀ *00 p* – – –(alb.)	... ...	... ...
	c^1 ♂ *100xp*26.26.17(6*f*)	c^2 ♂ *100xp*23.23.15(6*f*)	c^3 ♀ *100xp*23.23.15(6*f*)	c^4 ♀ *100xp*15.15.15(6*f*)	... ...	... ...
	c^5 ♀ *100xp*15.15.15(6*f*)	c^6 ♀ *100xp*15.15.10(6*f*)	c^7 ♀ *00 p* – – –(alb.)	... ...	... ...	... ...

*K*1	a^1 – *q* – – –(6*e*)	a^2 – *q* – – –(5*d*)	a^3 – *q* – – –(5*d*)	... ...	1*H*143b^2 ♂ *00 p* – – –(alb.)	1*H*120b^4 ♀ *100zq* 49.46.12(5*c*)
*K*2	a^1 – *q* – – –(5*c*)	a^2 – *q* – – –(5*c*)	a^3 – *q* – – –(5*d*)	a^4 – *q* – – –(4*c*)	1*H*143b^3 ♂ *100zq* 49.46.14(5*c*)	1*H*101b^5 ♀ *00 p* – – –(alb.)
	a^5 *00 p* – – –(alb.)	... ...	... ...	... ...	... ...	... ...
*K*3	a^1 – *q* – – –(5*c*)	a^2 – *q* – – –(5*c*)	a^3 – *q* – – –(5*c*)	... ...	1*H*109b^3 ♂ *00 p* – – –(alb.)	1*H*120b^5 ♀ *100zq* 49.48.43(5*c*)
*K*4	a^1 – *q* – – –(5*c*)	a^2 *00 p* – – –(alb.)	a^3 *00 p* – – –(alb.)	a^4 *00 p* – – –(alb.)	1*H*148b^2 ♂ *00 p* – – –(alb.)	1*H*111b^6 ♀ *100zq*58.57.55(6*e*)
*K*5	a^1 – *q* – – –(5*c*)	a^2 – *q* – – –(5*c*)	a^3 – *q* – – –(5*c*)	a^4 *00 p* – – –(alb.*w*)	1*H*111b^3 ♂ *60 q* 58.55. 1(3*e*)	1*H*148b^4 ♀ *00 p* – – –(alb.)
	a^5 *00 p* – – –(alb.)	a^6 *00 p* – – –(alb.)	... ...	... ...	... ...	... ...
*K*6	a^1 – *q* – – –(5*c*)	a^2 – *q* – – –(5*c*)	a^3 *00 p* – – –(alb. *w*)	a^4 *00 p* – – –(alb.)	1*H*111b^4 ♂ *00 p* – – –(alb.)	1*H*101b^3 ♀ *100xq*49.48.46(6*c*)
	a^5 *00 p* – – –(alb.)	a^6 *00 p* – – –(alb.)	a^7 *00 p* – – –(alb.)	... ...	... ...	... ...
*K*10	a^1 – *q* – – –(4*b*)	a^2 – *p* – – –(4*bw*)	a^3 – *p* – – –(3*bw*)	... ...	1*H*101b^4 ♂ *00 p* – – –(alb.)	1*H*36a^4 ♀ *30 r*37. 1. 1(2*c*)
*K*11	a^1 – *q* – – –(6*e*)	a^2 – *p* – – –(6*b*)	a^3 – *p* – – –(6*f*)	a^4 *00 p* – – –(alb.)	1*H*101b^1 ♂ *00 p* – – –(alb.)	1*H*32a^4 ♀ *100xq*58.57.55(6*e*)
*K*12	a^1 – *q* – – –(3*c*)	a^2 – *q* – – –(3*c*)	a^3 – *q* – – –(3*bc*)	a^4 *00 p* – – –(alb.)	1*H*120b^3 ♂ *00 p* – – –(alb.)	1*H*32a^3 ♀ *100zq* 49.46. 2(4*c*)
	a^5 *00 p* – – –(alb.)	... ...	... ...	... ...	... ...	... ...
*K*15	a^1 – *p* – – –(6*b*)	a^2 – *p* – – –(3*b*)	a^3 *00 p* – – –(alb.)	a^4 *00 p* – – –(alb.)	1*H*112a^4 ♂ *00 p* – – –(alb.)	1*H*117b^1 ♀ *100xq* 41.41.50(5*g*)
	a^6 *00 p* – – –(alb.)	... ...	... ...	... ...	... ...	... ...
*K*16	a^1 – *q* – – –(3*e*)	a^2 – *q* – – –(3*e*)	a^3 – *q* – – –(2*e*)	a^4 – *q* – – –(4*c*)	1*H*118b^6 ♂ *00 p* – – –(alb.)	1*H*124b^1 ♀ *65 q*58. 1. 1(3-4*e*)
	a^5 – *q* – – –(3*c*)	... ...	... ...	... ...	... ...	... ...
*K*19	a^1 – *q* – – –(4*c*)	a^2 – *q* – – –(3*c*)	a^3 *00 p* – – –(alb.)	... ...	1*H*119a^3 ♂ *55 q*49. 1. 1(3*c*)	1*H*149a^4 ♀ *00 p* – – –(alb.)
*K*21	a^1 – *q* – – –(6*e*)	a^2 – *q* – – –(6*d*)	a^3 – *q* – – –(4*c*)	a^4 – *q* – – –(4*e*)	1*H*114a^2 ♂ *10 q*58. 1. 1(1*e*)	1*H*152a^3 ♀ *00 p* – – –(alb.)
	a^5 – *q* – – –(4*e*)	... ...	... ...	... ...	... ...	... ...
*K*23	a^1 – *q* – – –(5*c*)	a^2 – *q* – – –(5*c*)	a^3 – *q* – – –(5*c*)	a^4 – *q* – – –(4*c*)	1*H*119a^5 ♂ *00 p* – – –(alb.)	1*H*87a^1 ♀ *100xq*58.58.57(6*e*)
	a^5 *00 p* – – –(alb.)	a^6 *00 p* – – –(alb.)	a^7 *00 p* – – –(alb.)	a^8 *00 p* – – –(alb.)	... ...	... ...
*K*24	a^1 – *q* – – –(1*e*)	a^2 – *q* – – –(2*c*)	a^3 – *q* – – –(2*c*)	a^4 *00 p* – – –(alb.)	1*H*100b^3 ♂ *00 p* – – –(alb.)	1*H*65b^2 ♀ *100xq*58.58.56(6*e*)
	a^5 *00 p* – – –(alb.)	a^6 *00 p* – – –(alb.)	... ...	... ...	... ...	... ...
*K*27	a^1 – *q* – – –(6*e*)	a^2 – *q* – – –(6*e*)	a^3 *00 p* – – –(alb.)	a^4 *00 p* – – –(alb.)	1*H*118a^2 ♂ *55 q*49. 1. 2(3*c*)	1*H*88b^2 ♀ *00 p* – – –(alb.)
	a^5 *00 p* – – –(alb.)	... ...	... ...	... ...	... ...	... ...
*K*28	a^1 – *q* – – –(5*c*)	a^2 – *q* – – –(4*c*)	a^3 – *q* – – –(4*c*)	a^4 – *q* – – –(6*g*)	1*H*122a^5 ♂ *25 q*46. 1. 1(2*c*)	1*H*16a^6 ♀ *00 p* – – –(alb.)
	a^5 *00 p* – – –(alb.)	a^6 *00 p* – – –(alb.)	a^7 *00 p* – – –(alb.)	... ...	... ...	... ...

Mating	Offspring				Parents	
					Father	Mother
*K*29	a^1 – *q* – – –(3*e*)	a^2 – *q* – – –(3*c*)	a^3 – *q* – – –(2*d*)	a^4 *00* *p* – – –(alb.)	1*H*121a^5 ♂ *55* *q*48.46. 2(3*c*)	1*H*16a^7 ♀ *00* *p* – – –(alb.)
	a^5 *00* *p* – – –(alb.)	a^6 *00* *p* – – –(alb.)	... ...	... ...	... ...	... ...
*K*30	a^1 *00* *p* – – –(alb.)	... ...	... ...	... ...	1*H*100a^2 ♂ *30* *q*46. 1. 1(2*c*)	1*H*152a^5 ♀ *00* *p* – – –(alb.)
*K*50	a^1 – *q* – – – –	a^2 – *p* – – – –	a^3 – *p* – – – –	a^4 – *p* – – – –	2*H*96a^1 ♂ *100xq*58.57.55(6*e*)	2*H*26a^2 ♀ *00* *p* – – –(alb.)
*K*53	a^1 – *q* – – – –	a^2 – *q* – – – –	a^3 ♂ *00* *p* – – –(alb.)	a^4 – *p* – – – –	2*H*156a^3 ♂ *100xq*58.57.55(6*e*)	2*H*52a^5 ♀ *00* *p* – – –(alb.)
	a^5 – *p* – – – –	a^6 – *p* – – – –	b^1 ♂ – *q* – – (5*e*)	b^2 – *q* – – – –	... ...	... ...
	b^3 – *q* – – – –	b^4 ♂ *00* *p* – – –(alb.)	b^5 ♂ *00* *p* – – –(alb.)	b^6 – *p* – – – –	... ...	... ...
	b^7 – *p* – – – –	c^1 – *q* – – – –	c^2 – *q* – – – –	c^3 – *q* – – – –	... ...	... ...
	c^4 – *q* – – – –	c^5 – *q* – – – –	c^6 – *p* – – – –	... ...	... ...	... ...
*K*54	a^1 – *q* – – – –	a^2 – *q* – – – –	a^3 – *q* – – – –	a^4 – *q* – – – –	2*H*49a^2 ♂ *100xq*58.57.55(6*e*)	2*H*63*b* ♀ *00* *p* – – –(alb.)
	a^5 – *p* – – – –	a^6 – *p* – – – –	b^1 ♂ – *q* – – (3*e*)	b^2 – *q* – – – –	... ...	... ...
	b^3 – *q* – – – –	b^4 – *q* – – – –	b^5 – *p* – – – –	b^6 – *p* – – – –	... ...	... ...
	b^7 – *p* – – – –	b^8 – *p* – – – –	c^1 – *q* – – – –	c^2 – *q* – – – –	... ...	... ...
*K*55	a^1 – *q* – – – –	a^2 – *q* – – – –	a^3 – *q* – – – –	a^4 ♂ *00* *p* – – –(alb.)	2*H*102a^1 ♂ *100xq*58.57.55(6*e*)	2*H*96a^7 ♀ *00* *p* – – –(alb.)
	a^5 – *p* – – – –	a^6 – *p* – – – –	b^1 – *q* – – – –	b^2 – *q* – – – –	... ...	... ...
	b^3 – *q* – – – –	b^4 – *q* – – – –	b^5 – *q* – – – –	b^6 – *p* – – – –	... ...	... ...
	b^7 – *p* – – – –	b^8 – *p* – – – –	c^1 – *q* – – – –	c^2 – *q* – – – –	... ...	... ...
	c^3 – *p* – – – –	... ...	... ...	... ...	... ...	... ...
*K*56	a^1 – *q* – – – –	a^2 – *q* – – – –	a^3 – *p* – – – –	b^1 – *q* – – – –	2*H*108a^2 ♂ *100xq*58.56.56(6*ew*)	2*H*113*a* ♀ *00* *p* – – –(alb.)
	b^2 – *p* – – ·	c^1 – *p* – – – –	c^2 – *p* – – – –	c^3 – *p* – – – –	... ...	... ...
	c^4 – *p* – – – –	... ...	... ...	... ...	... ...	... ...
*K*57	b^1 – *q* – – – –	b^2 – *q* – – – –	b^3 – *p* – – – –	b^4 – *p* – – – –	2*H*117a^1 ♂ – *q* – – –(6*e*)	2*H*116*a* ♀ *00* *p* – – –(alb.)
*K*59	a^1 ♂ – *q* – – –(6*e*)	a^2 ♀ – *q* – – –(*c*)	a^3 – *q* – – – –	a^4 – *q* – – – –	1*H*130b^1 ♂ *30* *p*37. 1. 1(2*a-b*)	2*H*147*a* ♀ *00* *p* – – –(alb.)
	a^5 – *q* – – – –	a^6 – *q* – – – –	a^7 – *q* – – – –	b^1 – *q* – – – –	... ...	... ...
	b^2 – *q* – – – –	b^3 – *q* – – – –	b^4 – *q* – – – –	b^5 – *q* – – – –	... ...	... ...
	b^6 – *q* – – – –	b^7 – *q* – – – –	b^8 – *q* – – – –	b^9 – *q* – – – –	... ...	... ...
	c^1 – *q* – – – –	c^2 – *q* – – – –	c^3 – *q* – – – –	c^4 – *q* – – – –	... ...	... ...
	c^5 – *q* – – – –	c^6 – *q* – – – –	c^7 – *q* – – – –	c^8 – *q* – – – –	... ...	... ...
	c^9 – *q* – – – –	c^{10} – *q* – – – –	... ...	... ...	... ...	... ...

EXPLANATION OF RECORDS.

In the nomenclature adopted by Weldon, $0H80$ (say) represents the eightieth cross of the original races, i.e. Japanese waltzers and ordinary white mice. The resulting offspring of the first litter of this cross are a^1, a^2, a^3, etc., of the second litter of the same cross b^1, b^2, b^3, etc., and of the third litter c^1, c^2, c^3, c^4, etc. The matings of hybrids are denoted by $1H90$ for the first generation of hybrids, $2H90$ for the second generation and so on. Thus a mouse $6H17b^2$ denotes that it was the second mouse of the second litter resulting from the 17 mating in the 6th generation of hybrids. The characters of any mouse are given by a scheme of the following kind:

$$4H64 \mid c^2 \,\delta\, 75q58.55.1(4e) \mid$$

This signifies that the mouse $4H64c^2$ was a male; 75 denotes that the pigmented areas covered ·75 of the total skin as determined by our scale of pigmented areas (see Plate I). *q* denotes that the eyes are black in this case, *p* would have marked that they were pink, the ordinary albino colour, *r* and *d.r* that they were red or dark red corresponding to blood and very dark blood colour; as a rule mice with such eyes have only incompletely albinotic eyes, i.e. there is more or less pigment found on dissection. The next three figures in the present case, 58, 55 and 1, mark the skin colour of the mouse on the mouse skin pigment scale of the Biometric Laboratory. This scale was formed by matching glass mosaics to the actual colours of the mouse skins. This scale contains 61 tints. Tints 1—9 are the "belly whites," leading up to 10—18, the palest blue greys; 19—27 are pale blue greys; 28—33 are yellow; 34—39, fawn yellow; 40—41 are chocolate; 43—45, chinchilla; 46—54, wild colour of various intensities, and 55—61, black of various intensities.

Of the three tints obtained from this scale the first, 58 in our case, marks the colour at the centre of the median plane of the skin, or if this should fall on a leucotic patch in the case of the piebald, the tint of the nearest dark patch. The second number gives the colour of the skin halfway between the centre of the back and the centre of the belly, 55 in our case; and the third number is that of the colour of the belly. Very often the first two numbers are the same, but we found in a good many cases that the tint shaded off from centre of the back to the belly, and our second number is a rough measure of the lightening of the pigment as we proceed from back towards belly. The final symbols given in brackets are Weldon's appreciation of the area of pigmentation given by the numbers 1 to 6 and his appreciation of colour as given by the letters *a*—*g*, *ch*. In the case of mice alive at his death and not then classed, these colour appreciations and pigment extents were provided as far as possible in accordance with his recorded judgments of other mice.

In the figures on p. 44, reproduced from *Biometrika*, Vol. III. p. 3, Fig. 6 represents a normal waltzing mouse.

Fig. 1 is Weldon's Class 1, more white and less extent of colour patches than a normal waltzer.

Fig. 2 is Weldon's Class 2, having about the same amount of colour patches as a normal waltzer.

Fig. 3 is Weldon's Class 3, having somewhat greater extent of colour patches than Class 2.

Fig. 4 is Weldon's Class 4.

Fig. 5 is Weldon's Class 5 with only a whitish belly.

Weldon's Class 6 is a whole colour mouse with nearly the same colour on the belly as on the back. Read with a planimeter Weldon's Classes are represented very roughly by:

1	2	3	4	5	6
14	53	68	77	92	100

We ourselves found considerable difficulty with "whole coloured" mice, and finally arranged them in three classes as follows:

$100x$ are mice with the skin pigmented all over, i.e. the same colour on belly as on the back; $100y$ are those with a line of paler belly pigment, but not sufficient to take the skin out of the

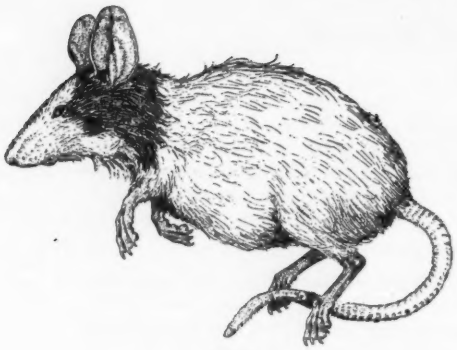


Fig. 1.

Fig. 2.

Fig. 3.

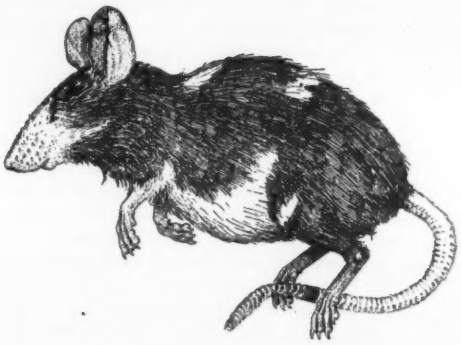


Fig. 4.

Fig. 5.

Fig. 6.

100 percentage; 100*z* have a skin pigmented all over, but a strip of paler belly colour which, if white, would make the skin fall in the 80 to 95 percentage classes. This means that our 100*x* and 100*y* ought to be Weldon's 6. As a rule our 100*z* are also his 6, but sometimes he denotes them by 5–6, and on some occasions he has called them 5. We have carefully considered these cases, but believe that our judgment, where not modified, must stand, as the belly pigment in these cases is often almost as intense as the back—e.g. 55 as against 58—and even when it is 9 against 19, this is not a pure white (1 only) but a shade of grey. We think our 100*x* for a pigmented belly with lighter hairs is more definite than terming the whole belly white, in which case our first number giving the extent of piebaldism would have to be modified, but the measurement would be exceedingly difficult as the pigment is there and only gets more plentiful towards the back. As a rule Darbishire and Weldon judged the amount of pigment on the living mouse and the nature of the belly pigment was not so open to full observation as when determined from the skin.

Weldon's colour classification was as follows:

a = yellow	*e* = black
b = fawn-yellow	*f* = pale blue grey ("lilac")
c = pale wild colour	*g* = chocolate
d = dark wild colour	*ch* = chinchilla

Roughly Weldon's *a* = our 28—33; his *b* = our 34—39; his *c* and *d* = our 46—54; his *e* = our 55—61; his *f* = our 10—27; his *g* = our 40—42; his *ch* = our 43—45. Naturally there is a good deal of personal equation in colour-determination, perhaps less with a colour scale than with mere verbal classification. Thus we should *a priori* have supposed *c* would range from about 46 to 49 or 50 and *d* from 50 to even 55 or 56. But we find *c* used for as dark a tint as 55 and *d* for as light a tint as 48. In the later records Weldon rarely, if ever, uses *d*, only *c*, so that its practical use is in the first or second hybrid generations, as in Mr Darbishire's paper. There *d* may be as low as 45, a tint we should call chinchilla. Our experience would make us doubt whether a rigid line can possibly be drawn between the various colour classes, with the possible but not certain exception of the yellows. Even here such judgments as *b–c* and *b–f* may occur. The differences of *d* and *e*, and *f* and *g*, may be so slight that intermediate classes may be formed as *d–e*, *f–g*.

A *w* following the Weldon colour class in the brackets at the end of the description of the individual mouse marks that it was a waltzer. Intermediates in colour or in piebald class are marked by a hyphen, e.g. *a–b* or 3–4.

Of the original stocks, the Japanese Waltzers were either bought or bred in the Laboratory. They were of pure stock, for they bred true to the parents when crossed only among themselves. There were very slight differences of the fawn colour in the body, and all eyes were pink. A waltzer is distinguished by the letter *W*, and as a rule by its laboratory number. The

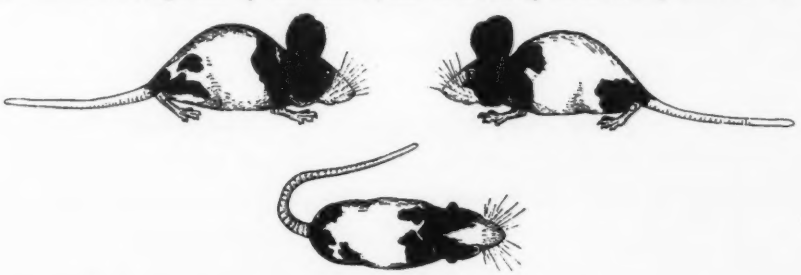


Fig. 7.

skins of these Waltzers were not preserved, but in the case of most of the animals a rough appreciation of the extent of the colour patches was conveyed by the use of the letters α and β and their combination $\alpha\beta$. Figure 7 on p. 45 represents an average waltzer $=(\alpha\beta)$, all waltzers with appreciably less colour are noted by α, all waltzers with appreciably more colour by β.

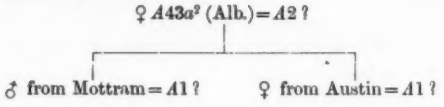
With regard to the albino parents we have distinguished ten classes, which are indicated in the following manner, the great difficulty is to be certain of the ancestry of albinos bought from dealers. In the Index Bt = Bought, Lb = Laboratory-bred.

Albino Classes.

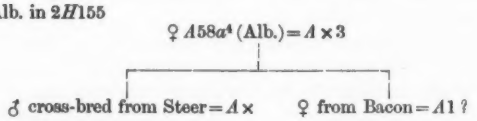
(1)	Parents and grandparents all albino, ancestry beyond unknown . . .	*A*2
(2)	Both parents albino, but one or more grandparents *known* not to be albino	*A* × 3
(3)	One parent albino, and the other not albino	*A* × 2
(4)	Neither parent albino	*A* × 1
(5)	Nothing known of ancestry	*A*1 ?
(6)	Said to be pure-bred albino	*A*1
(7)	Both parents albino, no definite knowledge of grandparents	*A*2 ?
(8)	Back to grandparents all albino, but beyond *known* to be cross-bred . .	*A*2 ×
(9)	Both parents and two grandparents known to be albino, no definite knowledge of the other two	*A*2½
(10)	Back to grandparents all albino, 1 or 2 grandparents pure bred albinos, no definite knowledge of others' ancestry	*A*1½

In Weldon's later breeding work on first crosses, i.e. the high numbered 0*H* and 1*H*, he paid much attention to the ancestry of his albinos, and the following pedigrees illustrate the ancestry in typical cases. The reader must note that the offspring stand at the *top* of the pedigrees, and we descend to parents and ancestry.

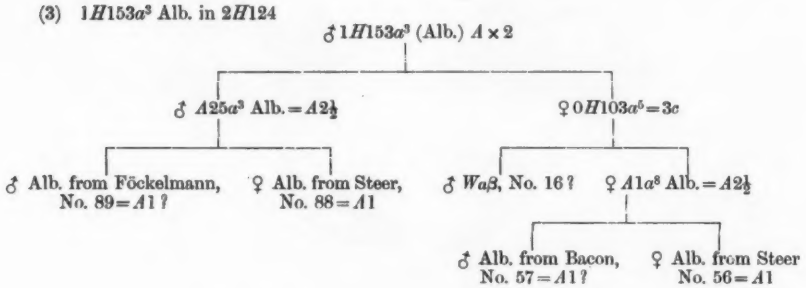
(1) *A*43a^2 Alb. in 1*H*143, 2*H*152



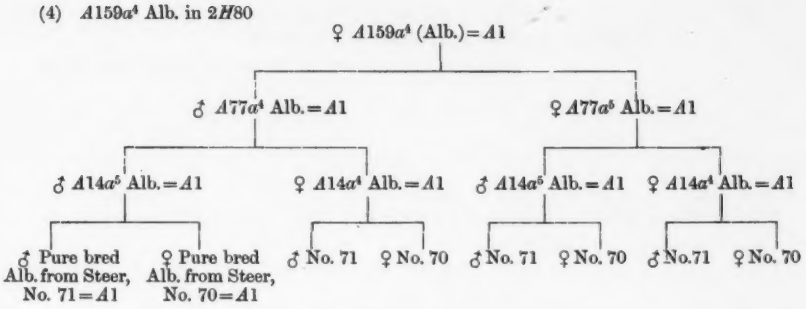
(2) *A*58a^4 Alb. in 2*H*155



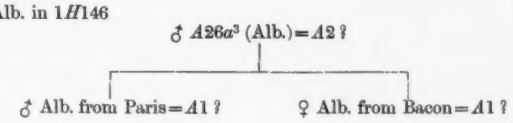
(3) 1*H*153a^3 Alb. in 2*H*124


♂ 1*H*153a^3 (Alb.) *A* × 2
♂ *A*25a^3 Alb. = *A*2½
♀ 0*H*103a^5 = 3α
♂ Alb. from Föckelmann, No. 89 = *A*1 ?
♀ Alb. from Steer, No. 88 = *A*1
♂ *Wa*β, No. 16 ?
♀ *A*1a^8 Alb. = *A*2½
♂ Alb. from Bacon, No. 57 = *A*1 ?
♀ Alb. from Steer No. 56 = *A*1

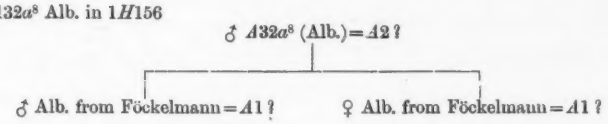
(4) *A*159a^4 Alb. in 2*H*80


♀ A159a⁴ (Alb.) = A1
♂ A77a⁴ Alb. = A1
♀ A77a⁵ Alb. = A1
♂ A14a⁵ Alb. = A1
♀ A14a⁴ Alb. = A1
♂ A14a⁵ Alb. = A1
♀ A14a⁴ Alb. = A1
♂ Pure bred Alb. from Steer, No. 71 = A1
♀ Pure bred Alb. from Steer, No. 70 = A1
♂ No. 71
♀ No. 70
♂ No. 71
♀ No. 70
♂ No. 71
♀ No. 70

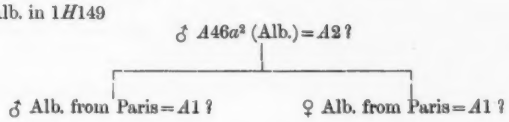
(5) *A*26a^3 Alb. in 1*H*146



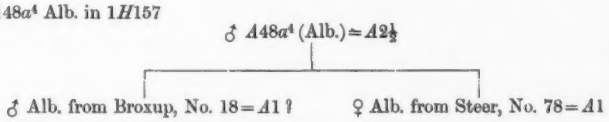
(6) *A*32a^8 Alb. in 1*H*156



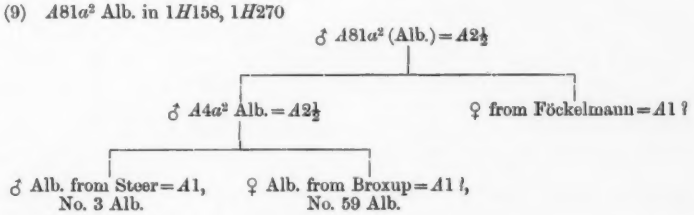
(7) *A*46a^2 Alb. in 1*H*149



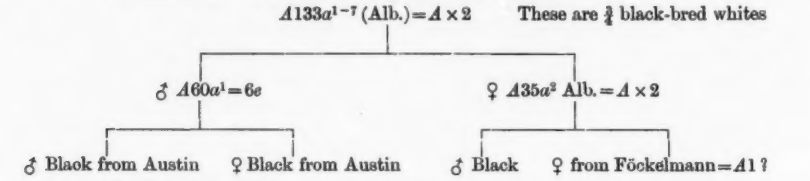
(8) *A*48a^4 Alb. in 1*H*157



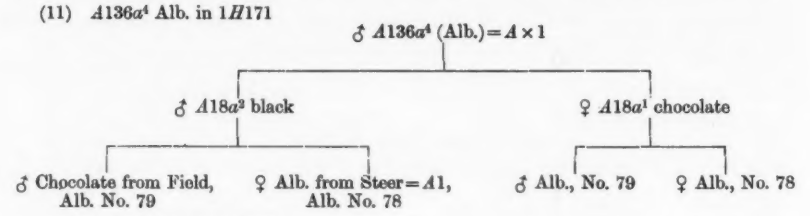
(9) *A*81a^2 Alb. in 1*H*158, 1*H*270



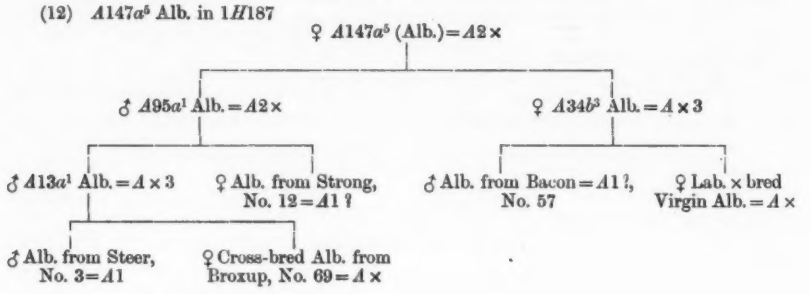
(10) ♀ *A*133a^1 Alb. in 1*H*164; ♀ *A*133a^2 Alb. in 1*H*165; ♀ *A*133a^4 Alb. in 1*H*167; ♂ *A*133a^6 Alb. in 1*H*168; ♂ *A*133a^7 Alb. in 1*H*169.


A133a1-7 (Alb.) = A × 2
These are ¾ black-bred whites
♂ A60a1 = 6e
♀ A35a2 Alb. = A × 2
♂ Black from Austin
♀ Black from Austin
♂ Black
♀ from Föckelmann = A1 ?

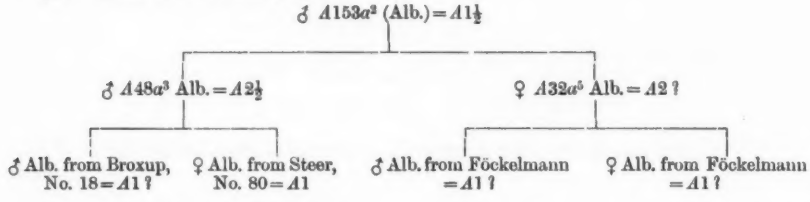
(11) *A*136a^4 Alb. in 1*H*171



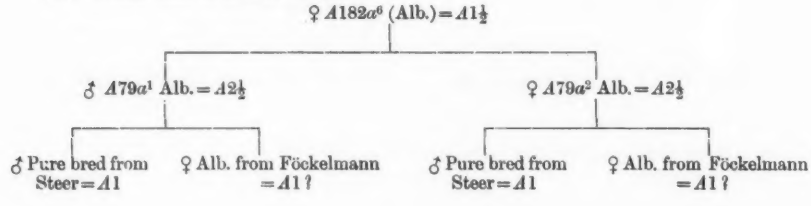
(12) *A*147a^5 Alb. in 1*H*187


♀ A147a5 (Alb.) = A2 ×
♂ A95a1 Alb. = A2 ×
♀ A34b3 Alb. = A × 3
♂ A13a1 Alb. = A × 3
♀ Alb. from Strong, No. 12 = A1 ?
♂ Alb. from Bacon = A1 ?, No. 57
♀ Lab. × bred Virgin Alb. = A ×
♂ Alb. from Steer, No. 3 = A1
♀ Cross-bred Alb. from Broxup, No. 69 = A ×

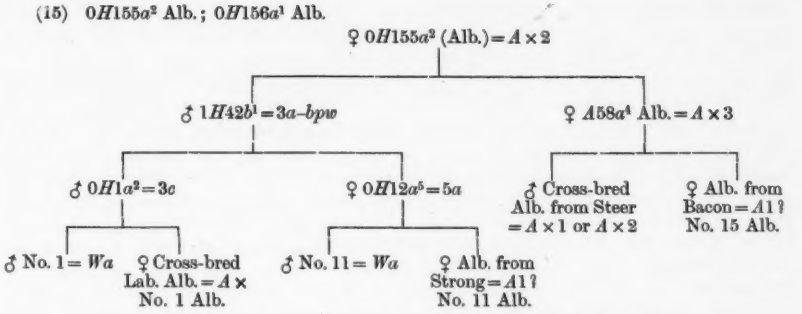
(13) *A*153a^2 Alb. in 1*H*183, 1*H*273


♂ A153a2 (Alb.) = A1½
♂ A48a3 Alb. = A2½
♀ A32a5 Alb. = A2 ?
♂ Alb. from Broxup, No. 18 = A1 ?
♀ Alb. from Steer, No. 80 = A1
♂ Alb. from Föckelmann = A1 ?
♀ Alb. from Föckelmann = A1 ?

(14) *A*182a^6 Alb. in *OH*164, 1*H*274


♀ A182a6 (Alb.) = A1½
♂ A79a1 Alb. = A2½
♀ A79a2 Alb. = A2½
♂ Pure bred from Steer = A1
♀ Alb. from Föckelmann = A1 ?
♂ Pure bred from Steer = A1
♀ Alb. from Föckelmann = A1 ?

(15) 0*H*155a^2 Alb.; 0*H*156a^1 Alb.


♀ 0*H*155a^2 (Alb.) = *A* × 2
♂ 1*H*42b^1 = 3*a*–*bpw*
♀ *A*58a^4 Alb. = *A* × 3
♂ 0*H*1a^2 = 3*c*
♀ 0*H*12a^5 = 5*a*
♂ Cross-bred Alb. from Steer = *A* × 1 or *A* × 2
♀ Alb. from Bacon = *A*1? No. 15 Alb.
♂ No. 1 = *Wa*
♀ Cross-bred Lab. Alb. = *A* × No. 1 Alb.
♂ No. 11 = *Wa*
♀ Alb. from Strong = *A*1? No. 11 Alb.

0*H*156a^1 is the same except that the mother is *A*58a^5 instead of a^4.

In the following Notes on Individual Mice, we have entered chiefly Weldon's remarks, but occasionally we show reason for differing from the account given of individual mice in Darbishire's memoir. We have only done so where on due consideration it seemed necessary, and chiefly because we found a wrong transcription from the records, or a characterisation not in accordance with the skins in our possession. From 0*H* to 2*H* matings we reproduce largely the results as given by Darbishire, although Weldon himself increased the number of these matings and had preserved for his own work all the skins possible. From 3*H* to 6*H* the matings are taken entirely from the card indices of Weldon, which were completed after his death when the stock in existence was killed and the skins preserved.

The notes we think throw considerable light on the difficulties of a large series of experiments of this kind; they mark the extent to which the mothers destroyed their offspring; the reasons why gaps occur in the matings, or in the skins preserved*; the occurrence of deformities or pathological states; the possibility of the young mating at a very early stage, and the difficulty of preventing at least some escapes. We note also how hard at times is colour classification by mere verbal categories. The following terms are abbreviated:

outbred = *OB*; cross-bred = *XB*; inbred = *IB*; pure-bred = *PB*.

NOTES ON INDIVIDUAL MICE.

0*H* *Matings.*

0*H*8 or 7 A wild coloured mouse from Cross 7 got loose but was caught; it was put back with the young of Cross 8. Anyone of the litter called 8*a* therefore may be 7*a*.—0*H*8 or 7a^2 A huge mouse, looks like a rat.—0*H*8 or 7a^6 Died young.—0*H*9a^1 Mangy.—0*H*17, 0*H*19 Young all eaten.—0*H*35a^3, 0*H*35a^4, 0*H*35a^5 Mangy.—0*H*45 In Book of Crosses it is distinctly stated under Cross 45 that the father was the ♂ from Cross 10. Under Cross 6 the ♂ from Cross 10 is said to be No. 6. No. 6 in picture is *Wβ* but under Cross 45 in *Biometrika*, Vol. III. the father is stated to be *Wa*.—0*H*45a^3 This mouse waltzed, but not in a very close circle.—0*H*53, 0*H*55 Young eaten.—0*H*61a^7 Skin not worth keeping.—0*H*62 Mother inbred 5 years.—0*H*72 Offspring died young.—0*H*84a^7 The colour of coat is almost cream.—0*H*84a^8 Escaped.—0*H*85a^6 Mange on face.—0*H*87 Offspring born dead.—0*H*90 Three offspring eaten.—0*H*91a^1 Died young.—

* Occasionally if two skins in one mating were identical only one was preserved, but usually all were kept, if possible.

0*H*99 Offspring born dead.—0*H*102a^6 Given away.—0*H*113a^1 Killed by relatives.—0*H*113a^3 Skin not kept.—0*H*113a^7 Killed by his doe.—0*H*113a^8 Escaped.—0*H*114a^1 Ill and killed.—0*H*117a^3 Mange on face.—0*H*120a^8 Unhealthy and very small.—0*H*124a^3 Escaped.—0*H*128 The two 3*cw* offspring were killed and mangled beyond recognition.—0*H*130, 0*H*131, 0*H*132 The three waltzer fathers are brothers.— 0*H*138a^2 Very small.—0*H*139a^5 Escaped.—0*H*142 Mother *OB*, *XB*. —0*H*142a^5 Skin destroyed.—0*H*143 Mother extracted recessive Albino from Prof. Cuénot.— 0*H*144 Mother refused to suckle young, so all died; mother *IB*, *PB*.—0*H*145 These 5's are catalogued as 6's. The colour is present but light on belly.—0*H*147 Several offspring died young; mother *IB*, *XB*.—0*H*150 Several offspring died young.—0*H*152a^5, 0*H*152a^6, 0*H*152a^7 Died young.—0*H*153 Several offspring died young. Two 4*c*'s are *w*.—0*H*156a^4 The lightest of *c*'s.— 0*H*159 Mother *OB*, *PB*.—0*H*159a^1, 0*H*159a^2, 0*H*159a^3, 0*H*159a^4 Escaped.—0*H*160 Mother *OB*, *PB*.—0*H*161, 0*H*162, 0*H*163 Mothers *IB*, *PB*.—0*H*163a^5 Died young.—0*H*165, 0*H*166 Mothers *OB*, *PB*.—0*H*166a^1 Escaped and killed.—0*H*167 Mother *OB*, *PB*.—0*H*168 Mother ate young.—0*H*169 Father *IB*, *PB*.—0*H*169a^1 Escaped.—0*H*170 Mother black inbred.—0*H*171 Mother black inbred.—0*H*172 Mother black inbred, several offspring died young.—0*H*175, 0*H*176 Mothers $\frac{1}{8}$ black bred.—0*H*179, 0*H*184 Mothers *OB*, *XB*.—0*H*185 Mother *IB*, *PB*.

1*H* *Matings.*

1*H*1 All 4 young died at birth.—1*H*3a^1, 1*H*3a^2 Died young.—1*H*3a^4, 1*H*3a^5 Very pale "wild."—1*H*4a^4 Escaped.—1*H*5a^4 Mangy.—1*H*6a^3 Escaped and died.—1*H*7a^3 Very light "wild." —1*H*9a^4 *Very* light *c*.—1*H*18a^1 Died young, also 2 albino offspring of 1*H*18 mating.—1*H*18a^4 No head movements.—1*H*19a^3, 1*H*28b^1 Escaped.—1*H*29a^2 Is misprinted *e* for *c* in *Biometrika* and so in Catalogue.—1*H*29a^3 Skin destroyed.—1*H*34*a*, 1*H*35*a* Both young born in the same cage, no good therefore and killed.—1*H*36a^4 The colour of the coat is intermediate between fawn and *c*.— 1*H*36a^5 The coat colour is nearer *c* than that of the last.—1*H*37a^2, 1*H*37a^4 The coat colour is intermediate between fawn and *c*.—1*H*42b^4 The coat colour is curious. There is a "blaze" of *c* on the face and top of head.—1*H*43a^2, 1*H*43a^3 Escaped.—1*H*43a^4 Too rotten to skin.— 1*H*46 All young killed.—1*H*49a^2 Described as chocolate; it is intermediate between chocolate and a very pale homogeneous *c*.—1*H*49b^5 Mangy.—1*H*51a^1, 1*H*51a^2 *Very* pale *c*.—1*H*55, 1*H*56 Note that the does in these two crosses are sisters, and that the one in 1*H*55 is crossed with an outbred pure-bred albino, and that the one in 1*H*56 is crossed with an inbred pure-bred albino.—1*H*55a^1 Colour only very slightly darker than fawn, though in the direction of *c*.— 1*H*56a^1 Mange.—1*H*57a^5, 1*H*57a^6 Died young.—1*H*58a^1 Colour between fawn and *c* with, perhaps, a soft chocolate tinge.—1*H*59a^1, 1*H*59a^5, 1*H*59a^6, 1*H*59a^7 Back legs paralysed of these albino young.—1*H*59a^4 The colour is rather a soft *c*.—1*H*60a^5 Mange and a damaged foot.—1*H*60a^6 Died young.—1*H*63a^4 The *d* is very soft.—1*H*64a^1 Skin not worth keeping.—1*H*64a^2 Rather tending to chocolate.—1*H*66a^2 The colour is not quite *f*: it has a suspicion of yellow in it.— 1*H*66a^4 The yellow is very dull, not unlike that of a normal waltzer, but merging very slightly to lilac.—1*H*66a^6 The colour is almost completely intermediate between that of a waltzer and lilac.—1*H*67 One ♂ and one ♀ offspring. Both mangy and killed.—1*H*68 Note that in 1*H*68, the only hybrid incest pair, there are 3 waltzers out of 5 young. One ♂ and one ♀ offspring mangy.—1*H*70a^2 Waltzer's colour.—1*H*70a^3 General form of waltzer. Mangled beyond recognition.—1*H*71 Albino offspring died young, the rest eaten.—1*H*72 Young eaten.—1*H*80a^6 The colour is a very pale chocolate.—1*H*81, 1*H*82, 1*H*83*a* Young born together: they are described as 81*a* and were killed.—1*H*84, 1*H*85*a* Born together. They are described as 1*H*84 and were chloroformed. 1*H*84 comes to an end. 1*H*85 goes on as 1*H*85*b*.—1*H*88, 1*H*89 Two or one family: born in cage before isolation; the young are described as 1*H*88*a* and were killed. One ♀ is left with ♂ as 1*H*88*b*. 1*H*89 comes to an end.—1*H*90, 1*H*91 Born together. 1*H*90 continued as 1*H*90*b*. 1*H*91 comes to an end. Young recorded and killed.

Note by W. F. R. WELDON:

The last two crosses had three objects (1st) to see whether whites (produced by crossing whites with first crosses) when crossed with first crosses—i.e. 1st generation hybrids—give the Mendelian numbers in their offspring, i.e. 50 °/₀ albinos and 50 °/₀ hybrids, (2nd) to see whether albinos produced in this way behave the same when crossed with waltzers as do ordinary pure-bred albinos, and (3rd) whether albinos whose ancestry has been "watered down" in this way for many generations will breed true when paired. With regard to the "watering down" of the albino ancestry of an albino, if hybrids at the first generation are paired with albinos, and the resulting albinos are paired back with hybrids of the first generation, the following table shows what happens:

The fractions in brackets after Hyb. or Alb. indicate the amount of albino ancestry in the animal.

Hyb.	$(\frac{1}{2})$ × *Alb.*	——	$\frac{3}{2}=1\frac{1}{2}$
Alb.	$(\frac{3}{4})$ × *Hyb.*	——	$\frac{5}{4}=1\frac{1}{4}$
Alb.	$(\frac{5}{8})$ × *Hyb.*	——	$\frac{9}{8}=1\frac{1}{8}$
Alb.	$(\frac{9}{16})$ × *Hyb.*	——	$\frac{17}{16}=1\frac{1}{16}$
Alb.	$(\frac{17}{32})$ × *Hyb.*	——	$\frac{33}{32}=1\frac{1}{32}$
Alb.	$(\frac{33}{64})$ × *Hyb.*	——	$\frac{65}{64}=1\frac{1}{64}$
Alb.	$(\frac{65}{128})$ × *Hyb.*	——	$\frac{129}{128}=1\frac{1}{128}$
Alb.	$(\frac{129}{256})$ × *Hyb.*	.....	

From which it will be seen that to find the albino ancestry of an albino in a given generation the denominator of the fraction indicating the albino ancestry of the previous generation must be doubled to produce that of the desired generation: and to find the numerator of the generation in question that of the previous one must be doubled and 1 subtracted.

But it is evident, that continually breeding back with a first cross is bad: because the ancestry of the desired albino can never be reduced below a half. The first step (that taken in 1*H*90 to 91) is all right because the ♀ in 1*H*91 is Alb. $(\frac{3}{4})$ and the young produced (i.e. 1*H*91$a^{1,2}$, etc.) will be alb. $(\frac{5}{8})$, i.e. an $\frac{1}{8}$ less albino ancestry $\frac{6}{8}=\frac{192}{256}$; then the degree in which the "watering down" diminishes is shown in the following series:

		$\frac{192}{256}$,	$\frac{144}{256}$,	$\frac{136}{256}$,	$\frac{132}{256}$,	$\frac{130}{256}$,	$\frac{129}{256}$,
or		16,	8,	4,	2,	1,	—
or	ancestry of ♀ in 1*H*91, i.e. *H*6a^2						=·750
	" " 1*H*91a^1, etc.						=·625
	" " Albino in next generation						=·562
	" " " " "						=·531
	" " " " "						=·515
	" " " " "						=·507
	" " " " "						=·503

that is to say starting with Alb. $(\frac{3}{4})$ (e.g. *H*6a^2 in 1*H*91) we can in the 6th generation produce Alb. (·503).

1*H*94 Parents doubtful, at any rate in colour of father and the 4 does *H*84*a* were pregnant when sexed. Offspring destroyed.—1*H*95 The parent females *H*62*a* etc. were pregnant when sexed.—1*H*95a^3 Colour a mixture, between fawn, chocolate and *c*.—1*H*95a^4 Colour pale chocolate.—1*H*95a^6 Killed by relations.—1*H*96a^2 Colour a very pale fawn.—1*H*97a^1 *Pale* fawn, with *little* white on belly.—1*H*98a^4 Much paler than a^3.—1*H*98a^5 Extremely like 1*H*98a^4, but with less white below.—1*H*98a^6 A very blue fawn colour.—1*H*99a^1 *Dark* fawn. The belly lighter but hardly any real white.—1*H*99a^2 Pale *c*. Skin not kept.—1*H*99a^4 Died young.—1*H*100a^3 Skin not kept.—1*H*100a^5 Rather dark fawn.—1*H*100a^6 Pale fawn.—1*H*101a^1 Colour a pale blue-grey,

like a mixture of fawn and lilac.—1*H*101a^4 Colour not black.—1*H*101a^5 Died young.—1*H*101a^7 No record except skin.—1*H*101b^6 Mixture of dark *b* and very pale chocolate with a look of fawn.—1*H*102a^3 Colour exactly intermediate between *b* and *c*.—1*H*102b^2 The palest lilac imaginable: if not placed beside an albino, it is taken for an albino.—1*H*102b^3 A pale but obvious *f*.—1*H*102b^4 A darker *f* than 1*H*102b^3.—1*H*103a^1 Colour dark fawn.—1*H*103a^2 Colour yellow fawn. Skin rotten and not kept.—1*H*103a^3 Colour very dark fawn or very pale "wild."—1*H*103b^3 The appearance, behaviour and complaints of waltzers are present in this mouse.—1*H*104a^5 Died young.—1*H*105a^3 Colour a brownish lavender.—1*H*105b^1 Escaped.—1*H*105b^2 Died young.—1*H*107a^1 *Very* pale "wild."—1*H*108, 1*H*109*a* All offspring died young.—1*H*109a^1 Very like pure race.—1*H*109a^2 Colour greyer than in 1*H*109a^1.—1*H*109b^5 Died young.—1*H*111a^1 A uniform pale grey almost intermediate between *a* and *e*.—1*H*111a^2 Colour a grey fawn. Died young.—1*H*111a^4 Colour paler than a^3 but the belly less white.—1*H*111a^6 Died young.—1*H*112a^3 Colour called *f* but it is really too brown for lilac.—1*H*112a^4 Exhibits waltzing tendencies.—1*H*114a^4 Skin not worth keeping.—1*H*115a^2, 1*H*115a^4 Died young.—1*H*115b^1 Some parts of ears are clothed with yellow hair.—1*H*117b^1 A sharp patch of white between fore legs, another much smaller on belly.—1*H*118b^3, 1*H*118b^7 Escaped.—1*H*121a^1 Colour very pale.—1*H*121a^3 Colour *very* dark.—1*H*121b^4 A very dark *d*.—1*H*121b^5 A measly specimen. Escaped.—1*H*122a^6, 1*H*122a^7 Skins not kept.—1*H*124a^1, 1*H*124a^4, 1*H*124a^5 Skins not kept. Head destroyed in 1*H*124a^1.—1*H*124b^4 Rather of a dark *b*.—1*H*124b^5 Died young.—1*H*125a^2, 1*H*125a^4, 1*H*125a^5, 1*H*125a^6, 1*H*125a^7 Skins not kept.—1*H*125*b* All offspring died.—1*H*126a^3 Died young.—1*H*126b^2 Waltzing and neurotic tendency very well pronounced.—1*H*126b^3 Called erroneously *e* in *Biometrika*, Vol. III.—1*H*127b^4 Darker than 1*H*127b^3.—1*H*127b^5 Mange.—1*H*128b^1 A dark *b*.—1*H*129a^1 Died before being painted.—1*H*129a^2 Skin not kept.—1*H*129*b* Catalogue, *Biometrika*, Vol. III. and skins differ wholly from Children of Hybrids record book.—1*H*129b^7 Died young. Only mentioned in mating book.—1*H*130a^2 Very pale *b*.—1*H*133b^1, 1*H*133b^2 Died young.—1*H*133b^3 Very pale.—1*H*133b^4, 1*H*133b^5 Very pale, died young.—1*H*135a^3, 1*H*135a^4 Died young.—1*H*136b^3 Colour intermediate between *b* and chocolate.—1*H*137a^1 Colour intermediate between chocolate and *c*.—1*H*137b^2 Died young.—1*H*137b^3, 1*H*138a^2, 1*H*138a^3 Died young.—1*H*139b^1 Called 6*e*. But by no means a pure black. Several hairs on chest, between front legs, have *brown* pigment; and a silvery appearance given by a very few scattered white (?) hairs on sides, and a very few on back. Claws white. Hair on hands and feet white: most caudal hairs white. Skin of tail pink with a few dark patches.—1*H*140a^1 Died young.—1*H*140a^2 Died Young. Distinctly a 5*c*. Called 6*c* in *Biometrika*, Vol. III. but 5*c* in Mating book.—1*H*140a^6 Died young.—1*H*142b^3 A *very small* admixture of long whitish hairs on sides and belly. Digits pink with some white hairs. Tail with patches of pink skin, and on these white hairs. Vibrissae black.—1*H*146b^5 Killed before sexing.—1*H*149a^6 Died young.—1*H*149b^4, 1*H*150b^3 Escaped.—1*H*152*b* Young eaten.—1*H*152c^6 Skin colour same as 1*H*152c^5.—1*H*153a^5, 1*H*154a^2, 1*H*155a^5, 1*H*155a^6 Escaped.—1*H*156a^1 The hair of the belly rather a dark brown than black. On haunches and sides of belly a *very* few white hairs. One or two white vibrissae. Nails pink. Digits and tail with white hairs.—1*H*158a^1 Killed accidentally.—1*H*160*a* Offspring died young.—1*H*161a^6 Eaten.—1*H*162a^1 Not very healthy, skin destroyed.—1*H*163a^1, 1*H*163a^3 Skins not kept.—1*H*164 Mother black bred.—1*H*164a^2 *c* very pale.—1*H*165, 1*H*166 Mothers black bred.—1*H*167 Mother again black bred.—1*H*168, 1*H*169 Fathers black bred.—1*H*170 Mother black bred.—1*H*170a^5 Very pale. (We should certainly have called it a pale blue grey verging on chocolate. K. P. and F. J. W.).—1*H*171, 1*H*172 Fathers black bred.—1*H*172a^4 Escaped.—1*H*172a^5 Killed accidentally.—1*H*173a^5 Really a very dark chocolate, a very wonderful colour.—1*H*177 All offspring eaten.—1*H*178a^3 Colour same as 1*H*178a^7.—1*H*179a^5, 1*H*179a^6 Coats same as 1*H*179a^3.—1*H*182a^6 Yellow underneath.—1*H*187*a* One stillborn offspring only.—1*H*196a^9 Skin identical with 1*H*196a^3.—1*H*201a^1 Very pale.—1*H*204a^2 Skin like 1*H*204a^1.—1*H*204a^4 Skin like 1*H*204a^3.—1*H*205a^2 Skin like 1*H*205a^1.—1*H*205a^6 Skin like 1*H*205a^3.—1*H*206a^7 Skin like 1*H*206a^6.—1*H*206, 1*H*207 Mothers *IB, PB*.—1*H*208, 1*H*209 Fathers *IB, PB*.—1*H*211a^3 (We

consider this mouse a chocolate. K. P. and F. J. W.).—1*H*217a^4 Colour almost chocolate.—1*H*220a^3, 1*H*220a^4, 1*H*220a^5 Escaped.—1*H*222a^6 Darker than 1*H*222a^5.—1*H*222a^8 Same colour as 1*H*222a^7.—1*H*227a^2 Not found in Catalogue.—1*H*237 Both parents from extracted albinos.—1*H*237a^4 Paler, more *f* than 1*H*237a^3.—1*H*237a^7 Little browner than 1*H*237a^6.—1*H*238 Both parents from extracted albinos.—1*H*238a^4 Skin like 1*H*238a^3.—1*H*239a^6 Escaped.—1*H*239, 1*H*240, 1*H*241, 1*H*242 Both parents from extracted albinos.—1*H*242a^4, 1*H*242a^5 Skins like 1*H*242a^3.—1*H*243, 1*H*244 Both parents from extracted albinos.—1*H*244a^3 Colour like 1*H*244a^2.—1*H*245 Both parents from extracted albinos.—1*H*246 Mother from Cuénot's extracted ♀ albino.—1*H*246a^4 Skin like 1*H*246a^3.—1*H*248 Both parents from extracted albinos, the mother from Cuénot's extracted ♀ albino.—1*H*248a^5, 1*H*248a^7 Colour like 1*H*248a^3.—1*H*249 Both parents from extracted albinos, the father from Cuénot's extracted ♀ albino.—1*H*249a^6 Colour like 1*H*249a^5.—1*H*250 Both parents from extracted albinos, the father from Cuénot's extracted ♀ albino.—1*H*250a^2 Skin not kept.—1*H*252 Both parents from extracted albinos.—1*H*252a^2 The waltzing movements of this mouse were extraordinary; it was incapable of locomotion.—1*H*253 Both parents are hybrids from the extracted *G'G'* 1*H*42b^1.—1*H*254 Mother is hybrid from the extracted *G'G'*, 1*H*42b^1.—1*H*255, 1*H*256, 1*H*257, 1*H*258 Both parents are hybrids from the extracted *G'G'* 1*H*42b^1.—1*H*262a^1 The *b* is curious: rather like a very pale *g*.—1*H*263 Both parents from extracted albinos.—1*H*266 One 5*a* offspring is a *w*.—1*H*270a^1 Black generally: but a few of the longer hairs on the sides and thighs white or yellow. A little white hair on the toes. The nails pink. The tail mottled brown and pink, the hairs on it white. A mixture of white hairs round the anus.—1*H*270a^4 Escaped.—1*H*273a^2 Considerable mixture of long brownish and whitish hairs over whole body. All digits and most of dorsum of R. pes with white hairs. Some brown (and white ?) vibrissae. Tail hairs mixed.—1*H*278, 1*H*280 Fathers are hybrid from the extracted *G'G'* 1*H*42b^1.—1*H*282 Young eaten.—1*H*292 One 5*c* offspring is *w*.—1*H*297 One 5*c* offspring is *w*.—1*H*301 Two of the 2*c* offspring are *w*.—1*H*308 One 2*c* offspring is *w*.—1*H*310 One 5*c* offspring is *w*.—1*H*312 One 2*c* offspring is *w*.—1*H*313a^2 No record except skin. 6*c* taken from skin.—1*H*324a^1 No record except skin. 2*c* taken from skin.—1*H*329 One 5*c* offspring and one 5*b* are *w*.

2*H* *Matings.*

2*H*12a^2 Darker than a^1.—2*H*12a^3 The colour simulates pale *g*.—2*H*22a^3 Skin like a^2.—2*H*22a^5 Skin like a^1.—2*H*27a^4 (Skin we think must be described as an *a* like the Catalogue and not *b*, *c* like *Biometrika*. K. P. and F. J. W.).—2*H*28a^5 Colour like a^2.—2*H*32a^3, 2*H*32a^4, 2*H*32a^5 Skins like a^2.—2*H*33a^5 Hardly any hair.—2*H*38a^1 Colour intermediate between chocolate and *c*.—2*H*38a^2 The *b* is dark tending to chocolate.—2*H*38a^4, 2*H*38a^5 The *b* is not very yellow.—2*H*40a^1 Homogeneous grey tending to chocolate.—2*H*40a^3 Tending to dark *b*.—2*H*45a^2, 2*H*45a^3 Colour like a^1.—2*H*49a^1 Much blacker than any hybrid in present stock. No white or brown hairs on back: a very few scattered brown and white hairs on sides; more on belly: and grey ring round perineum. Tail hairs white. Dorsum of digits white. Claws pink. Vibrissae all black.—2*H*49a^2 A distinctly greater mixture of yellow or brown hairs along sides of body than in 2*H*49a^1, and a group of very few white hairs in middle of belly. Dorsum of feet and hands with much pink skin and many white hairs. About ½ the tail pink: the tail hairs white. Brown hairs round base of ears, as is usual in "black" mice. Vibrissae black.—2*H*79$a^{2, 3, \text{or } 4}$ One of these 4*c*'s given as 5*c* in *Biometrika*:—2*H*79a^2 Colour like a^1.—2*H*79a^3, 2*H*79a^4 Skins like a^2.—2*H*79a^7 Skin like a^1.—2*H*82a^3 Skin like a^2.—2*H*92a^1 or a^2 One of these 3*c*'s is a waltzer.—2*H*93*b** Supplied from skins as no records are given.—2*H*96a^1 Fairly black. A few (very few) yellowish hairs on sides and haunches. Perineal patch grey; a good many wild-coloured hairs mixed with the black on belly, and a very small spot of a few nearly white hairs about umbilicus. Digits pink, with white hairs. Whiskers black. Hairs of tail some black (?), some white.—2*H*101a^2, a^3, a^4 or a^5 One of these 6*c*'s is a waltzer.—2*H*102a^1 Very good pure black dorsally: perineum, sides, and upper part of limbs with mixture of wild-coloured hairs.

A few white hairs on belly. Brown hairs round bases of ears well marked. Fingers and toes pink, with white hairs. Tail with dark skin, the hairs wild colour and white. Vibrissae black.—2*H*104*a*¹ or *a*² One of these is a waltzer.—2*H*108*a*¹ A very good black, with very few white and brown hairs on sides and belly. The perineal patch wild-coloured. Hardly any brown hairs at base of ears. Digits pink, with white hairs. Tail skin pink and dark. Hairs of tail some white, some brown or black. Vibrissae black.—2*H*108*a*² Colour almost like 2*H*108*a*¹, but with more brown hairs on belly.—2*H*109 One 4*c* offspring is a waltzer.—2*H*114*a*¹ A very good deep black, with a very few whitish hairs dorsally and few scattered brownish hairs on sides, and more, but not many, on belly. Hardly any brown hair round base of ears. Perineal patch grey. Digits white. Skin of tail pigmented, but many hairs white. Two or three white vibrissae on L. side, three on R. side, the rest black.—2*H*117*a*¹ A brownish black above, with considerable mixture of whitish or white hairs on limbs and a few on sides of trunk. Belly and perineal patch grey from mixture of white and brown hairs. Digits and dorsum of hands and feet with much white hair. Tail brown, with much white hair. Hair at base of ears pale brown. Some white vibrissae.—2*H*124*a*¹ A very black mouse, with very small admixture of brownish hairs on sides and belly. Perineal patch very small, brown. Hardly any brown hairs round base of ears. Toes and fingers pink with white hairs. Vibrissae black.—2*H*143 One 6*e* offspring is a waltzer.—2*H*147*a*¹ or *a*³ One of these has pink eyes.—2*H*151*a*¹, *a*³ or *a*⁴ One of these has pink eyes.—2*H*155*a*¹ Really very little white. A small patch of pure white on belly: the fingers and toes pink with white hairs. The skin of the tail nearly all dark, but with many white hairs. The rest a very good black with the long hairs darker than usual. Pale brown hair round base of ears. Vibrissae black.—2*H*155*a*² A good black with very few lighter hairs. Fingers and toes pink with white hairs: the tail skin pink for about ¼ its length, with white hairs. Brown hairs round base of ears. Whiskers black.—2*H*155*a*³ A fair black above, and at sides, with a very few white hairs. Perineal hairs mixed with white. Considerable mixture of white hairs on belly. Hairs round base of ears pale brown. Digits pink, and much white hair on hands and feet. Most of tail pink, the hairs white. Vibrissae black.—2*H*156*a*² A poor black, with many long, whitish hairs at sides. Perineal patch considerable, yellowish white. Belly with not much more white than sides. Much white hair on fore-limbs, and on hands and feet. Digits pink. Hair round base of ears very pale. Some white vibrissae.—2*H*156*a*³ Almost exactly like 2*H*156*a*², but the whitish hairs on sides and belly a little more plentiful.—2*H*156*a*⁴ Almost like 2*H*156*a*², but without any white whiskers, and with the hair round the base of the ears still paler.—2*H*300*a*² A very good black; extremely few brown or white hairs scattered on belly and perineal area. Skin of tail dark above, also below except near base. Vibrissae black. Most hairs on ears black, the rest deep brown. Claws pink. Dorsum of manus and pes black; white hairs on phalanges III, II, and parts of I in each digit.—2*H*300*b*³ Very good black. Very little brownish hair on belly and perineum. Ears and hair behind them brown. Phalanges of feet pink, with white hairs; those of hand darker, with few or no white hairs. Tail skin dark, with some white hairs. Whiskers black.—2*H*300*c*³ A good black: a little scattered (white? or) yellowish hair on sides and belly. Hands and feet pink. Tail pigmented with pale hairs. Many pale whiskers. Perineal patch small. Ears brown.—2*H*300*c*⁴ A rustier black than 2*H*300*c*³; the hands with more white hair: a little unpigmented skin round base of tail.—2*H*300*c*⁵ Generally like 2*H*300*c*³, but the pale hairs whiter, and the distal ¼ of the tail unpigmented.—2*H*301*a*¹ Much scattered pale brown (*b* or *c*?) hair on sides: belly with distinct brown tinge. Ears and hair behind brown. Tail dark with brown hairs. Distal phalanges of foot pink, with white hairs; those of manus pink with few or no white but some brown hairs.—2*H*301*a*² A very uniform brown-black, darker than *d*.—2*H*301*a*⁴ A yellowish lilac.—2*H*301*a*⁵ Little scattered pale (*a* and white) hair. Perineum pale *a*. Ears pale brown; hair behind them nearly white. Nostrils pink. All digits more or less pink, with pale or white hairs. Tail, skin darker above, paler below, with white hairs. Many vibrissae white.—2*H*301*a*⁶ General colour black, with a little scattered white hair; but about 3 very small white spots on R. haunch. Whiskers black. Otherwise like 2*H*301*a*⁵ —

$2H302b^2$ A good black: the scattered hairs distinctly yellow. Digits pale with yellowish hairs. Perineal patch yellowish. Tail pigmented with yellowish hairs. Many pale whiskers.—$2H302b^3$ Like $302b^2$ but with less coloured hair. The toes and tail darker.—$2H302b^4$ Small white blaze on forehead: white snout: white patch on belly: grizzly line on haunches.—$2H302b^5$ An extremely good black: even the digits with much pigment. Ears still brown.—$2H302b^6$ Body nearly or quite as black as $302b^5$, but the digits pink.—$2H302c^4$ Fair black. Long hairs on sides, and quarters yellowish white. Digits pink. Ears brown. Whiskers black. Tail pigmented with whitish hairs.—$2H302c^5$ Fair black. Long hairs on sides yellower than in $302c^4$. Digits pinker. Perineal patch larger and yellowish white. Some pale whiskers. Tail pigmented with whitish hairs.—$2H302c^6$ Rather more scattered pale hairs than $2H302c^5$. One or two isolated pale hairs on forehead. The digits pinker than in $302c^5$; the whiskers conspicuously mixed black and pale.—$2H303a^1$ A good black above: scattered pale hairs at sides and below: perineum pale grey. Ears brown: hair behind them pale. Most digits pink with white hairs. Skin of tail dark with white hairs. Some white vibrissae.—$2H303a^2$ Fair black. Feet, hands and tail pink, with white hairs. A white patch on one side of snout. All (?) whiskers white. A white patch across belly, running as narrow band up each side.—$2H303a^3$ A large white belly patch, with narrow white band obliquely across back. Hands, feet and tail pink.—$2H303a^4$ Body a good black, with very few pale hairs on belly and perineum. Tail dark, with some pale hairs below. Digits pink: those of R. pes with white hairs only: those of L. with fewer: those of manus with very few or none. Ears brown, the hair behind them brown. Whiskers black.—$2H303b^3$ Minute white patch on forehead: large white belly patch; faint white bar across haunches.—$2H303b^4$ Small white belly patch.—$2H303b^5$ A fair black. Hands and feet very pink, with white hair. The scattered lateral hairs more yellowish.—$2H304$ One black eyed offspring born dead, a mating previous to a.—$2H304a^3$ A fair black. Scattered yellowish hairs on sides. Perineal patch yellowish. Tail pigmented with pale hairs. Digits of manus slightly pigmented, of pes pink. Hair on and behind ears brown. Whiskers black.—$2H304a^6$ Good black. Few scattered yellowish hairs. Perineal patch yellowish. Digits pink. A few pale whiskers. Tail feebly pigmented with pale or nearly white hairs.—$2H304b^2$ Tail coloured.—$2H304b^3$ Tail ringed pink.—$2H305a^1$, $2H305a^3$, $2H305a^4$, $2H305a^5$ A yellowish lilac.—$2H307a^1$ Killed by ♀.—$2H308a^1$ A fairly typical fawn, the belly white.—$2H308a^2$ A pale and rather "blue" fawn. Belly coloured except for a small angular patch of pure white.—$2H308a^3$ A rather dark fawn. Belly white.—$2H308a^4$ A rather "blue" fawn: belly coloured with sharply defined white patch.—$2H308a^5$ Paler than a^4. The white of the belly comes on to the sides at the waist.—$2H308a^6$ Almost exactly intermediate between fawn and lilac. Belly white.—$2H309a^1$ A typical fawn. Skin not kept.—$2H309a^2$ A typical fawn.—$2H309a^3$, $2H309a^4$ Rather grey fawn.—$2H309c^1$, c^2, c^3, c^4 Died before sexing.—$2H309c^5$, c^6, c^7, c^8 Died and half eaten.—$2H312a^4$ Some scattered pale hairs at sides: belly with many pale hairs: perineum pale. Ears and hair behind them brown. Tail skin dark, with white hair, especially at tip. Digits pink with white hair. Some white vibrissae.—$2H312a^5$ A fair black: tail pinkish with white hairs, and a narrow linear streak of white on belly. Digits pink with white hairs.—$2H312b^1$ Escaped.—$2H312b^3$ Fairly uniform, but very rusty black. Perineum grey. Tail dark with white hairs. Hands and feet pink with white hairs. Ears and hair behind them brown.—$2H312b^6$ A good black. Ears dark brown, hair behind them lighter. Very little paleness on belly and perineum. Digits pink, with some white hairs.—$2H317$ Data marked * supplied from skins.

3H Matings.

$3H1a^2$ A dark chocolate.—$3H1a^3$ A yellowish lilac.—$3H1a^4$ A yellowish lilac: colour very uniform.—$3H1a^5$ A yellowish lilac: indistinguishable from $3H1a^4$.—$3H1a^8$ Some scattered light hairs on belly. Hairs behind ears nearly white. White hairs on digits. Whiskers black. Tail with dark skin.—$3H1b^3$ A rusty black, with scattered yellow (a ?) hairs. Belly and perineum with so much yellow hair that the mouse can hardly be put in Class 6. Ears brown: hair behind them

very pale. Feet pink: terminal phalanges of hand with white or pale yellow hairs. Tail skin dark, hairs pale. Whiskers black.—3*H*1*b*^{4} Body a good black above (darker than in 3*H*1*b*^{3}), belly and perineum with much yellowish scattered hair. Ears and hair behind them brown. All digits with white or pale hairs. Tail pigmented except at tip, with pale hairs. A few pale whiskers.—3*H*1*b*^{7} Almost exactly like 3*H*1*b*^{3}. Escaped.—3*H*2*a*^{3} A rusty black: a narrow pure white patch on belly; much scattered pale hair among black, at sides and below. Perineal patch with much white hair. Hair on and behind ears fawn coloured. Digits and dorsum of hands and feet with white hairs. Tail with patches of pink skin and some white hairs. Some pale whiskers.—3*H*2*a*^{4} No definite white patch but much scattered pale (fawn?) hair on sides and belly. Hands and feet with much pink skin and white (?) hair. *Tail* almost all dark skinned, with pale hair. Hair on ears pale fawn: behind ears nearly white. Vibrissae black.—3*H*2*a*^{7} Much scattered white hair. Much pink skin and white hair on hands, feet and tail. Hair behind ears whiter than in a^{4} Whiskers black.—3*H*2*b*^{4} Much fawn hair scattered on sides, more on belly. Perineum yellowish white. Tail skin feebly pigmented: hair light. Digits pink, almost all hair on them white or pale. Snout and chin with pale hairs. Hair on inside of ears and behind them pale fawn: on outside dark or black. A few fawn whiskers.—3*H*2*b*^{5} A good uniform lilac, but very pale (nearly white) at root of tail.—3*H*3*a*^{3} Poor black. Much scattered pale hair on sides: a very small spot (3—4 sq. mm.) pure white on belly. Digits pink, with white hairs; some white hairs on dorsum of hands and feet. Skin of tail dark near base, the rest pink. Caudal hairs all pale. Hair behind ears nearly or quite white: hair inside ears fawn. Some pale vibrissae.—3*H*3*a*^{4} Black: much scattered pale (white?) hair on sides and belly. Perineum nearly white. Only last 2 phalanges of digits pink. Hair behind ears dark; within ears very pale. Some pale whiskers. Tail dark skinned with pale hair.—3*H*3*a*^{5} Black, with little mixture of pale hairs. Digits pink, with white hairs. A pink portion, with white hair, near extremity of tail. Some pale whiskers.—3*H*3*a*^{8} Very pale "pearl grey" rather than "lilac."—3*H*3*b*^{3} More white than 3*b*^{3}.—3*H*3*b*^{4} A good black above: a fair quantity of scattered fawn hair on belly, on fore-limbs and throat. Perineal patch pale fawn. Tail skin pigmented, hair fawn. Digits pink, hair white or fawn. Hair within and behind ears pale. Many pale whiskers.—3*H*3*b*^{5} A very good black. Few scattered fawn hairs on sides, belly and throat. Tail pigmented except at tip: its hairs white or pale. Digits pink, hairs white or pale. Perineum with very little pale hair. Inside and behind ears, hair fawn: darker outside. Whiskers black.—3*H*3*b*^{6} A good black above: dark slaty grey, with small median white patch, below. Digits and whole R. foot, pink with white hairs. Tail nearly all pink. Many pale whiskers.—3*H*3*b*^{7} Like 3*b*^{5}, but with less pale hair, and with no pink on tail.—3*H*3*b*^{9} A very good black: very little pale hair on belly and throat. Digits pink, with some pale hair. Tail pigmented. Whiskers black.—3*H*3*c*^{3} Died before sexing.—3*H*4*a*^{5} Good black. Very few scattered pale hairs. Terminal phalanges pink, with white hairs. Perineal patch very dark. Tail pale-skinned, but not pink, with light hairs. Hair within and behind ears pale. Vibrissae black.—3*H*4*a*^{6} Very like 4*a*^{5}, but feet whiter, and tip of tail pink.—3*H*4*b*^{1} A very small patch pure white in middle of belly. Digits pink. Terminal 12—15 mm. of tail pink.—3*H*4*b*^{2} A good black, with scattered pale hairs ventrally. Perineal patch small. Only phalanges II and III pink, except on R. foot, where they are all pink. Tail slightly pigmented, with small pink patches; hair fawn (?). Hair on and behind ears brown. Many pale whiskers.—3*H*4*b*^{3} Almost exactly like 4*b*^{2}, but both hind feet have pink digits.—3*H*4*c*^{3} Small white belly streak.—3*H*4*c*^{7} Dwarf.—3*H*5*a*^{1} A very dark chocolate: eyes quite black.—3*H*5*a*^{2} Good black. Some scattered (fawn?) hair on sides and belly. Very little pale hair behind ears: hair within ears brown. Digits pink, with white hair. Tail feebly pigmented, with about 1 cm. at end pink: the hair fawn (?). Some pale whiskers.—3*H*5*a*^{3} More pink on toes than a^{2}, and $\frac{1}{3}$ of tail pink.—3*H*5*a*^{4} Less pink on toes than a^{2}, and none on tail.—3*H*5*b*^{3} A good black: some scattered (fawn?) hair below: perineal patch small. Terminal cm. of tail pink. Hair behind ears very pale. Digits feebly pigmented.—3*H*5*b*^{4} Much as 5*b*^{3}, but digits pink, and tail ringed with pink.—3*H*5*b*^{7} A good black, like 5*b*^{3}, but with the

digits pink.—3*H*6*a*² A good black: very little scattered light hair; a small white spot on forehead. Belly with much scattered white hair and a pure white patch. Hair in and behind ears brown. Digits and all L. hand pink with white hairs. More than ½ the tail pink skinned, with white hairs. Whiskers mostly white.—3*H*6*a*³ Rusty black: scattered white hairs on sides: perineal patch very pale: belly almost slate-coloured, with linear central streak of white. Tail feebly pigmented, the hair white. Hair in ears brown. Digits white. Some white whiskers.—3*H*6*a*⁴ Back and sides fairly good black. Snout and whiskers white, with white streak on forehead. Hair behind ears nearly white, within ears pale yellow. Digits and parts of dorsum of manus and pes pink, with white hairs. Tail pink, with patches of pale pigment, the hair white. Belly grey (i.e. black with much scattered white hair), with large central white patch.—3*H*6*b*¹ Fair black above: much scattered white hair at sides and below. Tail pigmented, hair white. Digits pink with white hairs. Perineal patch whitish. Hair on ears yellow, nearly white behind ears. Whiskers black.—3*H*6*b*² A very slaty black: much diffuse white hair, and about a dozen conspicuous white hairs on forehead. Hands and feet with much white hair. Many white whiskers.—3*H*6*b*³ Very like 3*H*6*b*².—3*H*6*b*⁴ Very like 3*H*6*b*².—3*H*6*b*⁵ Median white belly patch.—3*H*6*c*⁴ Mange.—3*H*7*a*¹ Very good black dorsally: perineum yellowish, belly with fair mixture of light hairs. Tail dark, hair yellowish except at the extreme tip, where it is pure white. Hair behind ears black, inside ears yellow. Skin of ears darker than usual. Digits dark, with extremely little light hair.—3*H*7*a*³ Much light hair on sides and belly. Perineal patch almost white. Hair behind ears almost white: within ears pale yellow. Much white on digits and on dorsum of L. foot. Tail with patches of dark and of pink skin, early all the hair white. Whiskers black.—3*H*7*a*⁴ Almost identical with 7*a*³, but with less white on the ears.—3*H*7*a*⁵ Almost like 7*a*³, but with more pink at tip of tail.—3*H*7*b*¹ A rusty black dorsally, the belly dark slate grey. All digits and dorsum of hands and feet pink, with much pale hair. Tail feebly pigmented, the hair pale. Hair behind ears pale, inside ears yellow. Many pale whiskers. Perineal patch yellow-white.—3*H*7*b*² Body a good black; slightly grey below, from a little scattered pale hair. Perineum yellow-white. Feet and the digits of the hands white. Tail feebly pigmented, the hairs white. Very few pale hairs behind ears. A few pale whiskers.—3*H*7*b*⁵ A rusty black above: belly grey, with faint linear white streak.—3*H*8*a*³ A very rusty black. Hind feet and digits of hands white; ⅔ of tail pink, with white hair on all the tail. Belly with much diffuse white hair, and a small white patch. Pale patch behind ear well marked. Hair within ears yellow. Some light whiskers.—3*H*9*a*² Generally a good black, with scattered whitish hairs at sides, and a line of thickly grouped whitish hairs, making a very pale band, along middle of belly. Perineal patch pale yellowish white. Pale tufts behind ears well marked: hair inside ears yellow: some white whiskers. Skin of tail dark except at tip, where it is bright pink: the tail hair white. Fingers white. The R. toes and part of dorsum of R. foot white; only terminal phalanges of L. foot white.—3*H*9*a*³ No white patch, but much scattered pale hair on sides and shoulders. The pale hair yellowish. Perineal patch yellow. Digits white. Extreme tip of tail white. Pale patch behind ear less conspicuous than in *a*². Some whiskers pale.—3*H*10*c*² Eye-colour not noted (but *not* pink).—3*H*11*a*¹ Poor black, with much pale or white hair on sides, fore-limbs, and inside of thighs: rather less on belly. Digits white. Tail feebly pigmented below, darker above. Pale patch behind ears very small: hair inside ears yellow. Nearly all whiskers pale.—3*H*11*a*² Nearly completely white below (belly darkened with age).—3*H*11*a*⁴ Poor black, but with little scattered pale hair. Perineal patch very pale. Hair behind ears nearly white: hair within ears yellow. Terminal phalanges of digits white. Tail with pigmented skin but with white hair. Some whiskers white.—3*H*11*a*⁵ Almost like *a*⁴, but with more white on toes.—3*H*11*a*⁶ A pale ring on tail. A patch of densely clustered white hairs on belly. Otherwise like *a*⁴.—3*H*11*a*⁷ Exactly like *a*⁵. Later; developed much brown hair on shoulders.—3*H*12*b* Nine offspring born, seven eaten.—3*H*14*a*⁴ A "chinchilla" mixture of black and white.—3*H*14*a*⁵ "Chinchilla" grey like *a*⁴.—3*H*14*b*¹ The black with a good many scattered white hairs. Cf. the chinchilla of 14*a*.—3*H*14*b*³ The black with scattered white hairs.—3*H*14*c*¹

"Grey"="chinchilla" mixture of dark grey or black hairs with white ones.—$3H25a^2$ Much white on head: fawn patch round each ear: fawn patch on L. side, and large patch on hind quarters.—$3H25a^3$ Head and much of shoulders fawn: white blaze on face. Large fawn patch on hind quarters: no lateral patch.—$3H25a^4$ Head fawn with white streak on forehead. Fawn continued backwards on left side as large patch. A large fawn patch on hind quarters. Much white on right side.—$3H25a^5$ Head and shoulders fawn: muzzle white: hind quarters fawn: large blotches of fawn on L. side and over back to R. side. Much more colour than the others.—$3H25a^6$ Head and shoulder patch small. Snout white. Hind quarter patch small. —$3H25a^7$ Snout white. Head and shoulder patch larger. A patch on R. side. Hind quarter patch small.—$3H25a^8$ Head with practically no white. Patch on hind quarters divided.—$3H26a^1$ Head patch covers both eyes.—$3H26a^2$ Head patch very small: area round L. eye white.—$3H29a^3$ Escaped.—$3H31$ *Z* 139 albino mother pure-bred for 3 generations.—$3H31a^1$ A fairly uniform, very dark black: the tail with some pink: the belly slightly paler than the back. Digits white haired. Whiskers black. Patch behind ears not very light.—$3H31a^2$ Perfect wild-colour, grey beneath.—$3H31a^3$ Perfect wild-colour, grey beneath, but the tail ringed with pink.—$3H31a^6$ With some pink on tail.—$3H31b^7$ With much pink on tail.—$3H31b^8$ With a little pink on tail.—$3H33$ The *Z* mother pure-bred for 3 generations.—$3H33a^1$ Fair black, with few scattered light hairs. Belly with more light hair. Perineum nearly white. Tail very slightly pigmented with white hair. Digits pink, with white hair. Some white hair on dorsum of pes. Ears pale. Hair behind them very pale. Some white whiskers. Tip of muzzle with some white hairs.—$3H33a^2$ A very fair black: belly darker than in a^1: perineum yellowish. Some white on digits, but less than in a^1. Many white whiskers. Ears as in a^1.—$3H33a^3$, $3H33a^4$ Almost identical with a^2.—$3H33a^5$ Very good black. Perineum nearly white. Digits pink with white hair. Tail pigmented, with little pink patch near extremity. Ears darker than in males: a few white whiskers.—$3H33a^6$ Very like a^5 but no pink on tail and no (?) pale whiskers. Perineum and hair on tail yellowish.—$3H37a^1$ Killed by brother.—$3H39b^3$ A dwarf.—$3H40$ Ancestry black.—$3H40a^2$ Killed by brother.—$3H42$ Ancestry fawn.—$3H42a^1$ Disappeared and record lost.—$3H50a^2$ Dark lilac.—$3H51b^3$ Minute white ventral spot.—$3H53a^1$ Mangy.—$3H53c^4$ Belly pale but not white.—$3H59a^1$ Very dark chocolate. Eyes black.—$3H59b^1$ Ears malformed.—$3H59b^3$ Very small white ventral streak.—$3H61a^2$, $3H61a^3$ Small white belly patch.—$3H64a^2$ Very small white ventral patch.—$3H64a^3$ Very pale lilac.—$3H65b^1$ Small ventral white streak.—$3H65b^2$ Small oblique ventral streak.—$3H65b^3$ Very small linear ventral streak.—$3H65c^3$ Fairly large ventral patch.—$3H65c^4$ Small ventral patch.—$3H65c^5$ Very small ventral patch.—$3H66b^3$, $3H66b^4$, $3H66b^5$ Very dark lilac.—$3H66b^6$, $3H66b^7$ Very brown lilac.—$3H71a^1$, $3H71a^2$, $3H71a^3$, $3H71a^4$ Dwarfs.

4H Matings.

$4H1a^1$ Extremely good black above, dark slate colour below. Longer hairs at sides, and perineal patch, yellowish. Tail pigmented, hairs yellowish. Digits pink, with pale hairs. Hair on and behind ears brown. Whiskers black.—$4H1a^2$ Like $4H1a^1$, but the long hairs more nearly white and some whiskers white.—$4H1a^3$ Like $4H1a^1$, but more pink on feet.—$4H2a^2$ Good black above. Scattered hairs on sides and belly fawn. Digits pink.—$4H2a^3$ Like $4H2a^2$, but with less scattered fawn hair.—$4H2c^3$ Tip of tail pink.—$4H3b^1$ Fair black: little scattered very pale (? white) hair at sides. Perineal patch nearly white. Hair behind ears very pale yellow. Digits pink, hairs white. Tail pigmented, with white hairs. Many white whiskers.—$4H3b^2$ Better black than $3b^1$; no white whiskers.—$4H3b^3$ Good black. Scattered hairs yellower than in the other two: tail pink at end: toes much pinker than in $3b^1$ or $3b^2$.—$4H3b^5$ A very good black, with few scattered pale hairs. Some whiskers white. Digits pink with white hair. Tail pink except at base and tip.—$4H3b^6$ Like $4H3b^5$, but tail pigmented.—$4H4a^2$ Good black above. Tail pigmented. Digits pink, with white hairs. Some white whiskers. Ear hairs brown. Slaty grey below, with very small linear streak of nearly pure white (say 5 mm. × ½ mm.)

on belly.—4H4a³ Very small white blaze on forehead: white patch on belly.—4H4a⁴ Minute white streak on forehead: larger but still very small white streak on belly. Most of the whiskers white. Digits pink with white hairs. Tail mottled pink and white.—4H4b¹ Narrow white belly streak. Tail pink.—4H4b² White speck on forehead. Trace of white ventral streak. Tail pink.—4H6a² Blaze on forehead: large white patch on belly.—4H6b¹ Small white blaze on forehead, long patch on belly.—4H6b² No blaze on forehead: white patch on belly.—4H6b³ Like 4H6b³, but a smaller mouse.—4H6b⁴ White blaze on forehead: white belly patch.—4H6b⁵ No blaze. White belly patch.—4H6c² Streak on belly.—4H6c³ Blaze on forehead; streak on belly. —4H7a¹ Small white ventral patch, unusually far back.—4H7a² Very faint streak of scattered white hairs on belly.—4H8 Ancestry black.—4H12a¹, 4H12a², 4H12a³ Dwarfs.—4H12a⁴ No record.—4H12a⁵, 4H12a⁶ Dwarfs.—4H12a⁷ Omitted in Index, referred to in Mating Book, no record.—4H13b¹ Small blaze on forehead and *very* thin white band across haunches.— 4H13b⁶ Very small white blaze on forehead.—4H14a¹, 4H14a², 4H14a³, 4H14a⁴, 4H14a⁵, 4H14a⁶ Belly uniformly white.—4H15a² Dark lilac.— 4H15a³, 4H15a⁴ Very pale lilac.— 4H15b³ Very pale lilac—pearl grey. Killed (tumour).—4H16b³ White face.—4H17a³ Bred with one brother before sexing as 5H1.—4H20b³ Small linear white streak on belly.—4H20b⁴ Belly white.—4H23a¹, 4H23a² Eaten.—4H23b³ Small white belly streak.—4H23c¹, 4H23c² *Very* little white on belly.—4H24a¹ A very good black above: scattered white hairs below. Tail pigmented. Fingers slightly pigmented, toes pink. Whiskers black. Perineal patch small. Faint trace of white line below appeared later.—4H24a² Small white line on back part of belly. Tail ringed pink and dark.—4H24a³ Good black above: scattered greyish hairs sides and below. Digits pink. Whiskers black. Tail pigmented.—4H24b¹, 4H24b², 4H24b⁴, 4H24b⁵, 4H24c¹, 4H24c² Dwarfs.—4H25x This the only young of the first brood. Eaten. Next brood called 4H25a.—4H25a¹ A good black. Very little scattered pale hair. Digits largely pigmented. Tail pigmented. Whiskers black.—4H25a² A good black. Very like 4H25a¹ but digits pinker. —4H26a² Much scattered hair (nearly white) at sides. Some white whiskers. Fingers and all feet pink. Tail pigmented.—4H26a³ Face and most of belly pure white.—4H26a⁵ Few scattered white hairs close together on belly.—4H27 Ancestry black. Father uncertain.—4H27c¹ Dwarf. —4H28 Ancestry black. Father uncertain.—4H28a¹, 4H28a² Linear white belly streak.— 4H29 Father's ancestry fawn, mother's ancestry black.—4H30a⁷, 4H30a⁸ Escaped while brood was being sexed.—4H33a² Much scattered pale hair ventrally. Tail partly pink.—4H36a⁴ Mangy.—4H38, 4H39, 4H40 Ancestry black.—4H40a¹ Very pale. Face nearly white.—4H41, 4H45 Ancestry black.—4H45b¹ Very light *f.*—4H45b², 4H45b⁵ Dark *f.*—4H46b⁴ The palest "coloured" mouse yet seen.—4H49c² Killed by brothers.—4H51a² Very small ventral streak.— 4H51a⁵ Very small linear white ventral streak.—4H51b⁴ Perhaps a trace of ventral white.— 4H52a³ Very small ventral streak.—4H58b³ Nearest intermediate between lilac and chocolate yet seen.—4H63a³ Albino with traces of colour on shoulders.—4H66a¹ Trace of white *dorsal* streak.—4H66a² Merest trace of ventral white streak.—4H66a⁶ Trace of blaze on forehead.— 4H66b³ Small white ventral patch.—4H69 Fawn ancestry.—4H69b¹ Small white patch.— 4H69b² Belly white.—4H71 Ancestry black.—4H75a² Record lost.—4H84b⁵ A few white hairs on belly.

5H *Matings.*

5H1a⁵ Escaped.—5H3x Eaten soon after birth.—5H8a¹ Very small white ventral streak.— 5H8a³ Very pale lilac.—5H8a⁴ Small forehead blaze.—5H8b⁵ Small white ventral patch.— 5H8c¹ Dark lilac.—5H8c² Pale lilac.—5H8c³, 5H8c⁴ Dark lilac.—5H10a³ Very small ventral streak and forehead blaze.—5H10a⁵ Very small forehead blaze. No ventral streak.—5H11a⁵ Escaped.—5H12a³ Dwarf.—5H12b¹ Very small white patch on forehead.—5H14a⁴ Few white ventral hairs.—5H15a² Tip of tail pink.—5H15a³ Tail lost.—5H15b² Small round belly patch.— 5H19b⁴ Few white hairs on forehead.—5H19b⁵ Very few white hairs on forehead.—5H29b² Very small white patch.—5H30b³ Extremely pale (nearly white). Ought to have a new colour

category.—5*H*30*b*[4] Normal lilac.—5*H*31*b*[3], 5*H*31*b*[4] Very small ventral group of white hairs.—5*H*31*b*[6] Few white hairs on belly.—5*H*32*b*[1] Poor black, but no white patch ventrally: small white patch on forehead.—5*H*32*b*[4] Scattered white ventral hairs.—5*H*35*a*[1] Escaped.—5*H*37*a*[1] Belly very pale but *not* white.—5*H*37*b*[3] Pale.—5*H*40*a*[1] Belly pale but not white.—5*H*40*a*[5] Escaped.—5*H*40*b*[1] Trace of white ventral group of hairs.—5*H*52*a*[3] Escaped.—5*H*54*a*[1] Very pale.—5*H*54*b*[1] Very small ventral streak.—5*H*62*a*[1] A faint streak of white on belly.—5*H*82*a*[4], 5*H*82*a*[5], 5*H*82*a*[6] A few white hairs on belly.

6*H* *Matings.*

6*H*1*a*[7] White blaze on nose.—6*H*7*b*[6] A small patch of white hairs on belly.—6*H*11*a*[3] Small white patch on back.—6*H*15*c*[5], 6*H*17*c*[3], 6*H*17*c*[6], 6*H*18*a*[6], 6*H*25*a*[1] A few white hairs on belly.—6*H*27 Fawn ancestry.—6*H*28 Black ancestry.—6*H*28*b*[3] A few white hairs on belly.—6*H*28*c*[5] No record except skin.—6*H*29, 6*H*30 Black ancestry.—6*H*33*a*[3], 6*H*34*a*[1], 6*H*34*a*[2], 6*H*35*a*[3], 6*H*35*a*[4], 6*H*35*a*[5] Very pale.

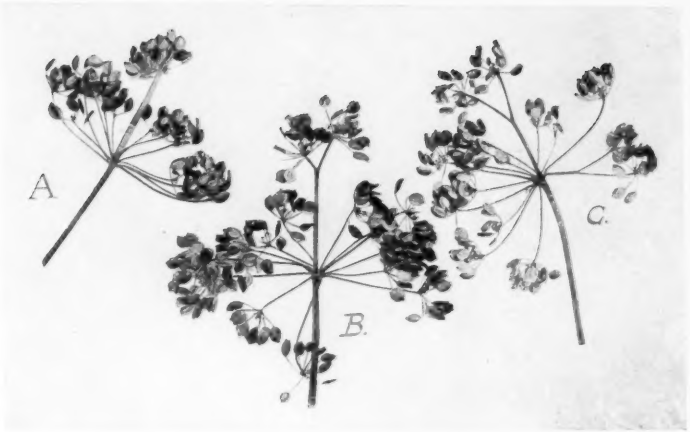
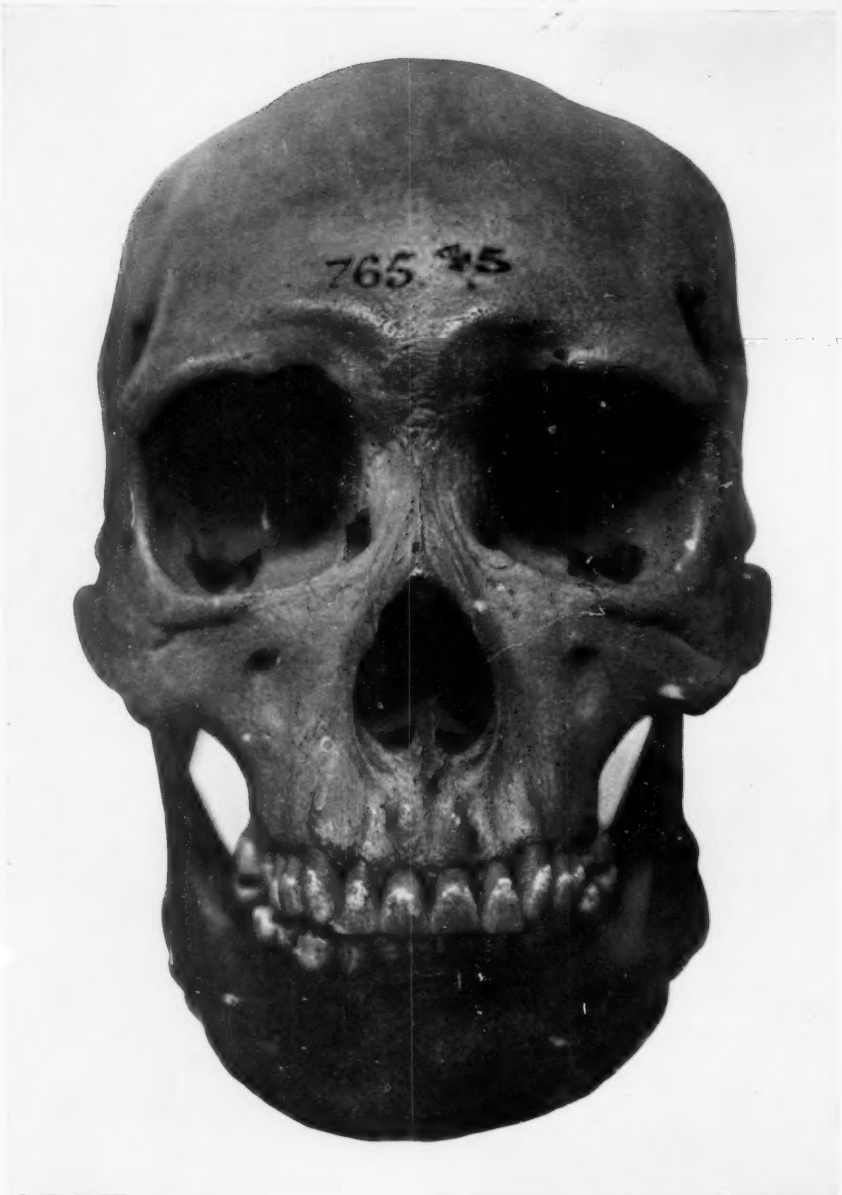


FIG. 1. *A* represents an umbel with one fasciation of two rays which are united to the top, *B* an umbel with one fasciation of two rays which are not united to the top, *C* an umbel with two fasciations each of two rays with union somewhat lower

FIG. 2. *D* represents an umbel with two fasciations, one of two and the other of three rays, *E* an umbel with one fasciation of four rays, *F* an umbel with three fasciations each of two umbel rays

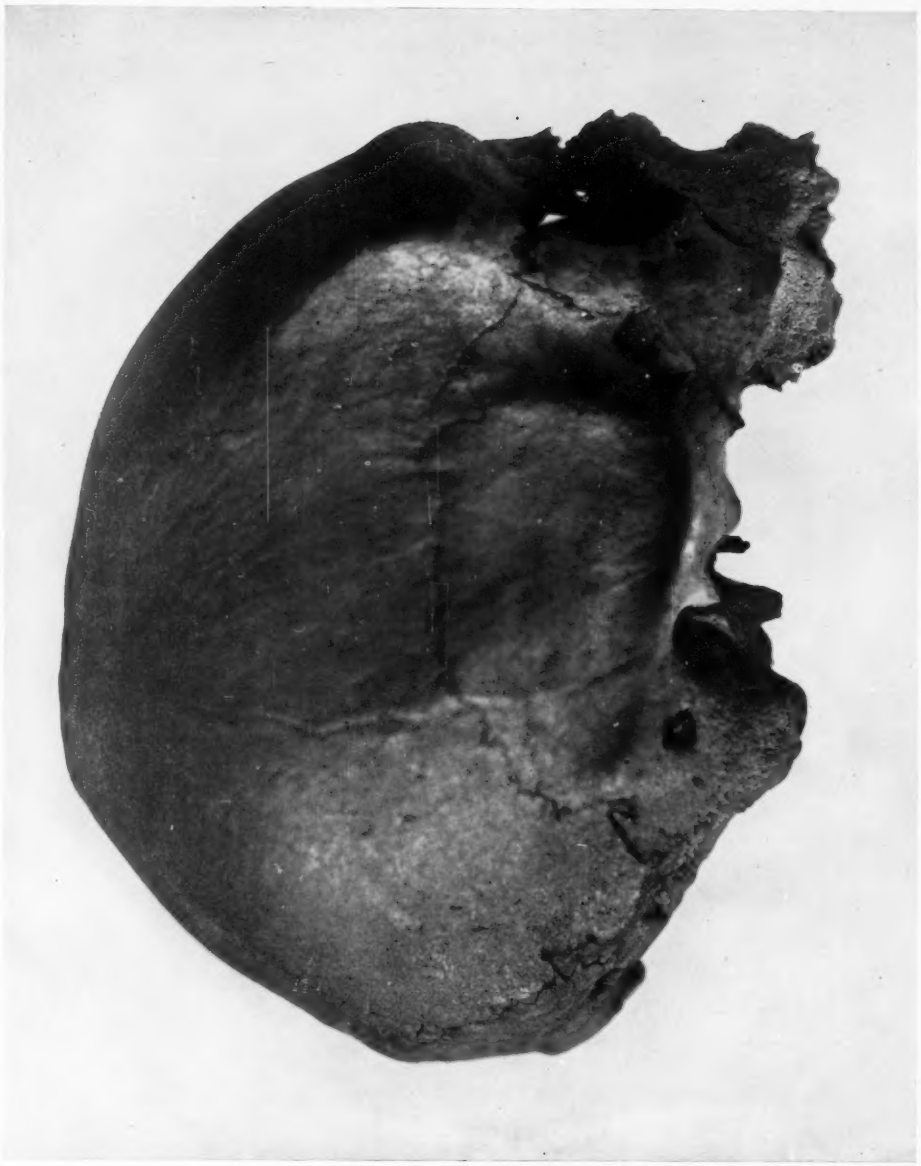
Special Fasciations of *Pastinaca sativa*



Moriori Crania. Typical Male Skull, No. 765^{45}. *N. facialis*

Moriori Crania. Typical Male Skull, No. 7654^{5}. *N. lateralis*

Moriori Crania. Typical Male Skull, No. 765[45]. *N. occipitalis*



Moriori Crania. Typical Male Skull, No. 765[10]. *N. lateralis*

Moriori Crania. Typical Male Skull, No. 765[16]. *N. occipitalis*

Moriori Crania. Typical Male Skull, No. 765[25]. *N. lateralis*

Moriori Crania. Typical Male Skull, No. 765[25]. *N. basalis*

Moriori Crania. Typical Female Skull, No. 765. *N. lateralis*

Moriori Crania. Typical Female Skull, No. 765[33]. *N. lateralis*

Moriori Crania. Typical Female Skull, No. 763. *N. verticalis*

Moriori Crania. Typical Female Skull, No. 763. *N. basalis*

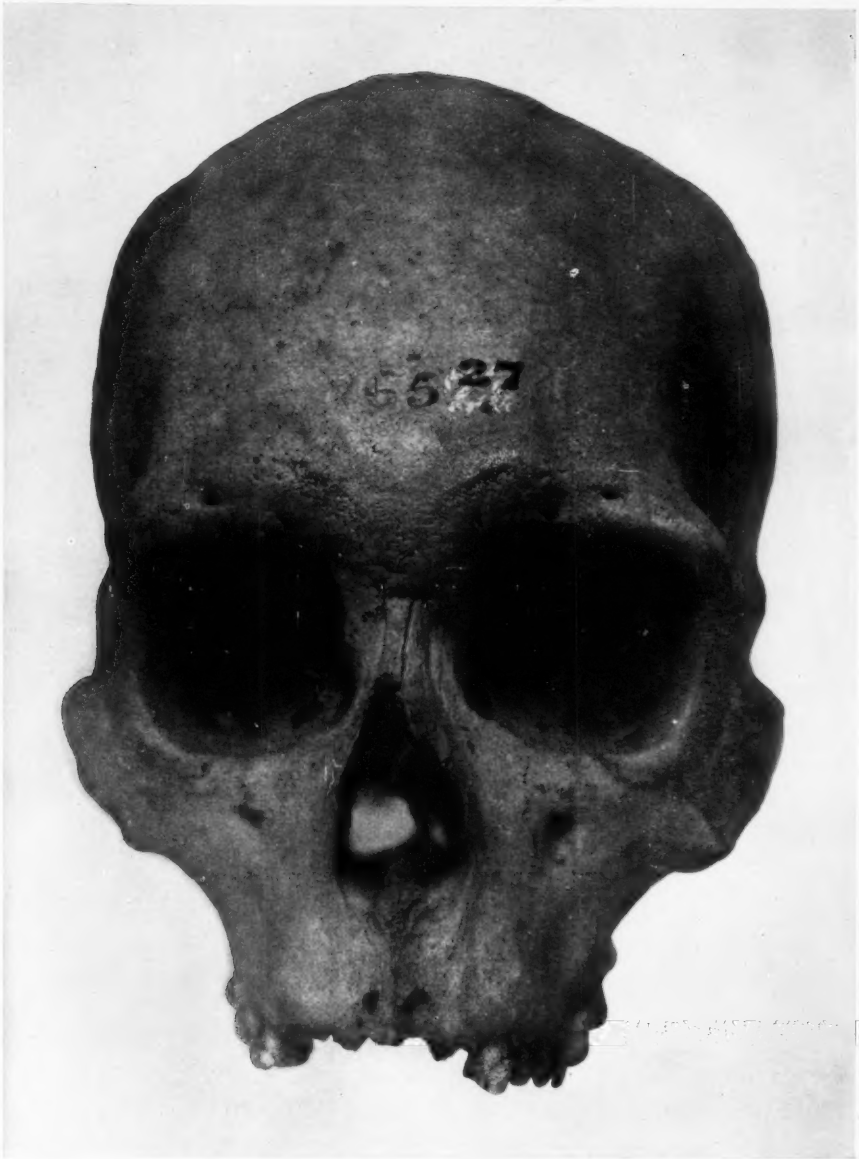
Moriori Crania. Male Skull, No. 765[5]. Marked asymmetry of foramen magnum. *N. occipitalis*

Moriori Crania. Male Skull, No. 765[5]. *N. lateralis*

Moriori Crania. Male Skull, No. 762. Ossicle of coronal suture; occipital bathrocephalic in character. *N. lateralis*

Moriori Crania. Male Skull, No. 762. Ossicles of the lambdoid suture. *N. occipitalis*

Moriori Crania. Male Skull, No. 765♂, with epipteric. *N. lateralis*



Moriori Crania. Male Skull, No. 765^{27}. Massive glabella. *N. facialis*

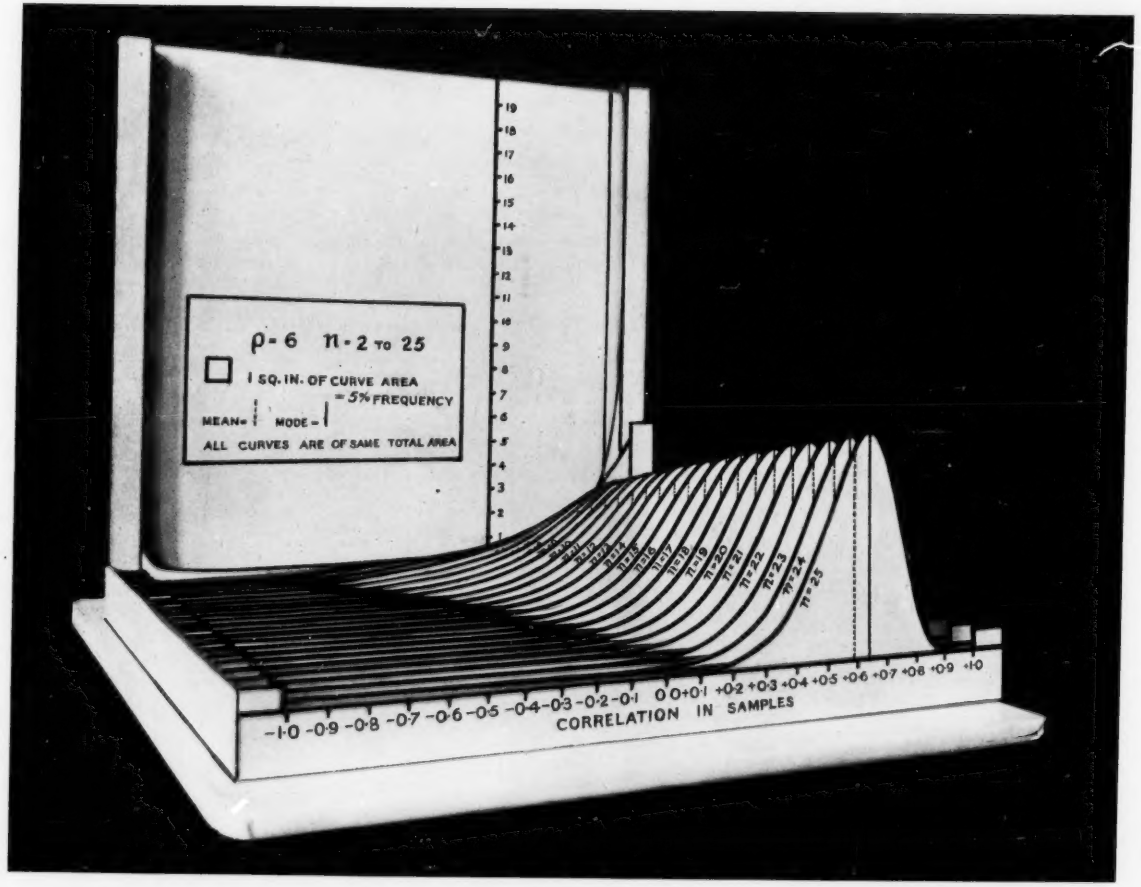
Moriori Crania. Skull, No. 765[17], with marked bilateral paraoccipital processes articulating with atlas.
For a unilateral case: see *Biometrika*, Vol. v. p. 104, Plate X

Moriori Crania. Male Skull, No. 765², illustrating fracture of left ramus of mandible. *N. lateralis*, R. side with sound ramus

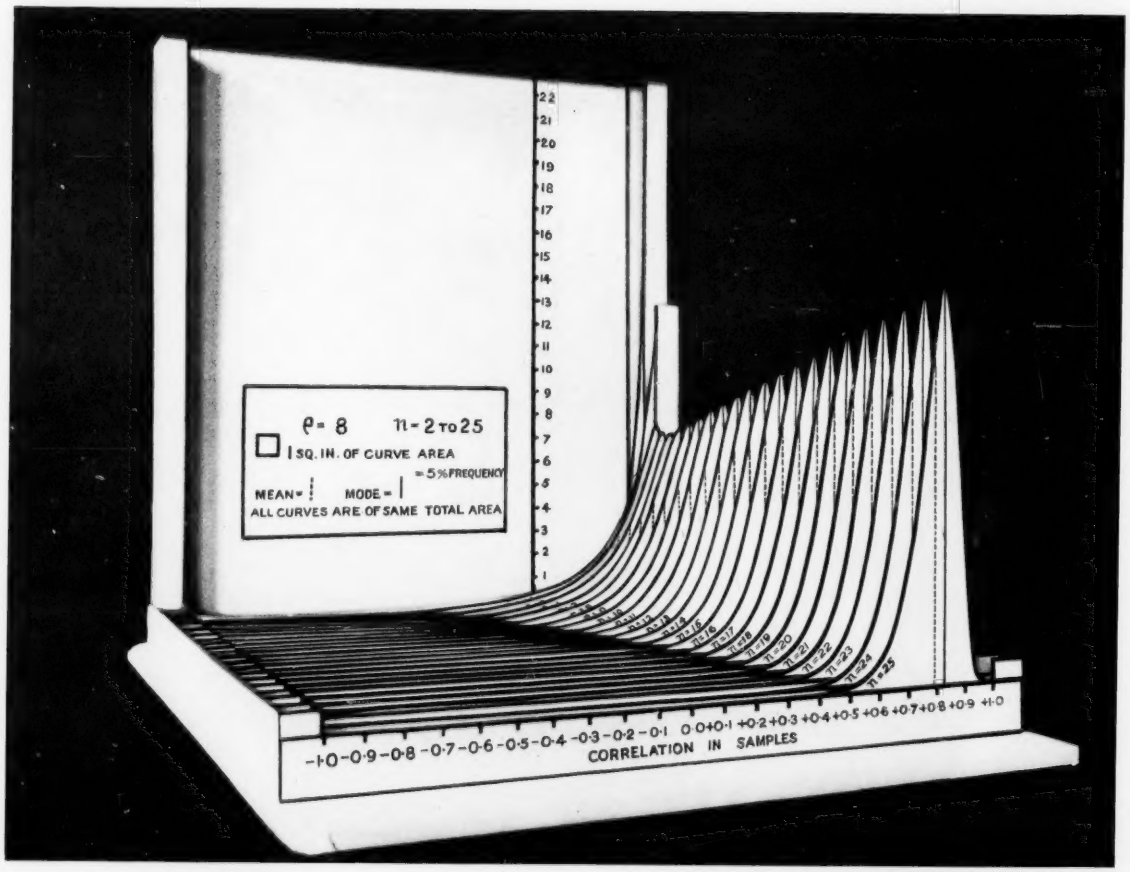
Moriori Crania. Male Skull, No. 765[2], illustrating fracture of left ramus of mandible. *N. facialis*, showing asymmetry produced by the injury

Moriori Crania. Male Skull, No. 765², illustrating fracture of left ramus of mandible. *N. lateralis*, L. side with healed fracture and dwarfing of ramus and perigonal region

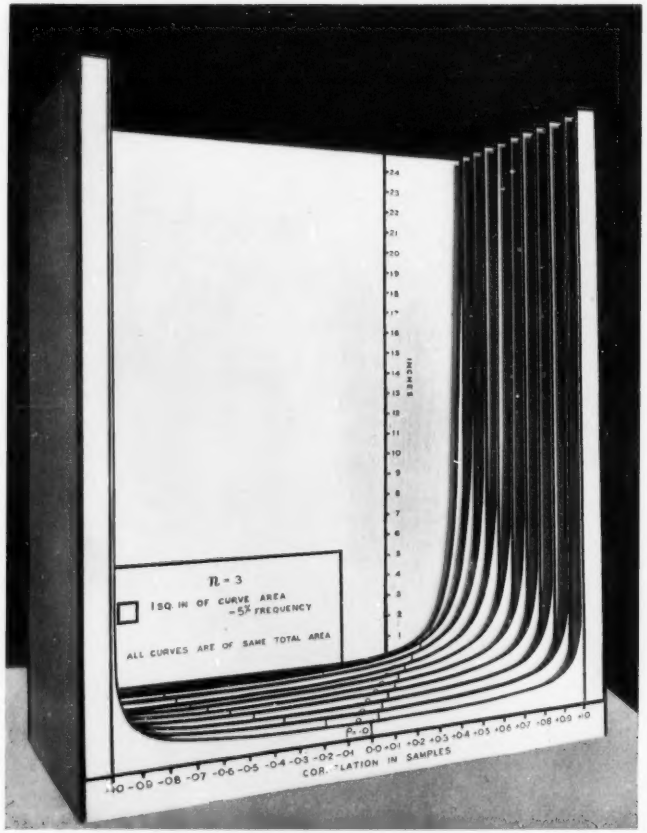
W. R. MACDONELL (1852–1916)
Contributor to and Assistant Editor of *Biometrika*

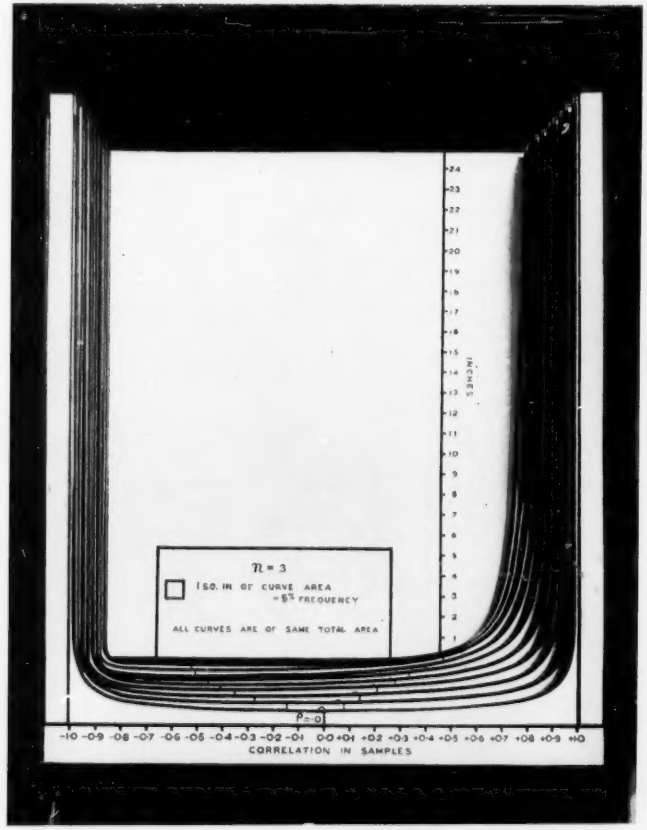


Correlation in Small Samples. $\rho = 0{\cdot}6$. Frequency curves for samples of sizes two to twenty-five, showing the changes in type from a skew "cocked hat" to J- and U-forms. Model A

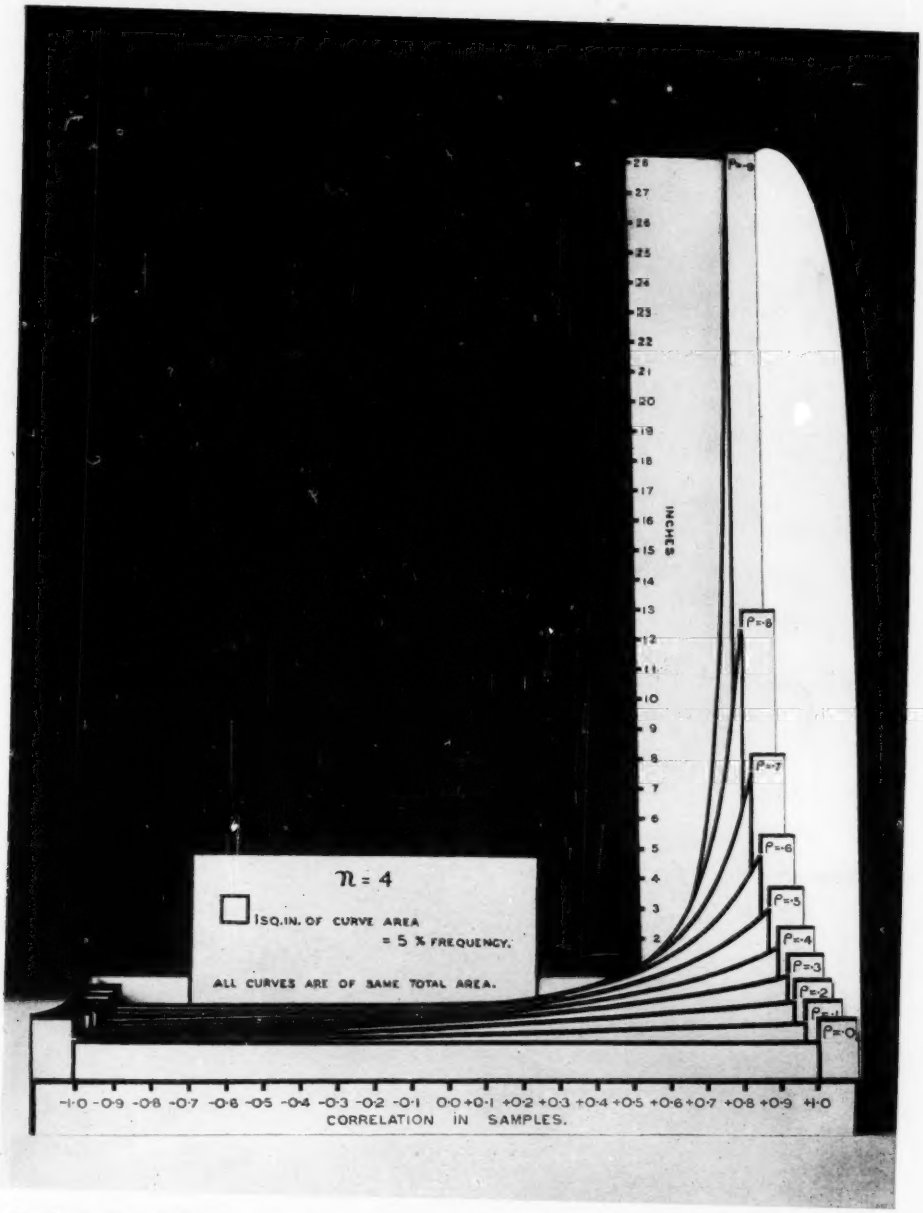


Correlation in Small Samples. $\rho = 0{\cdot}8$. Frequency curves for samples of sizes two to twenty-five, showing the changes in type from a skew "cocked hat" to J- and U-forms. Model B

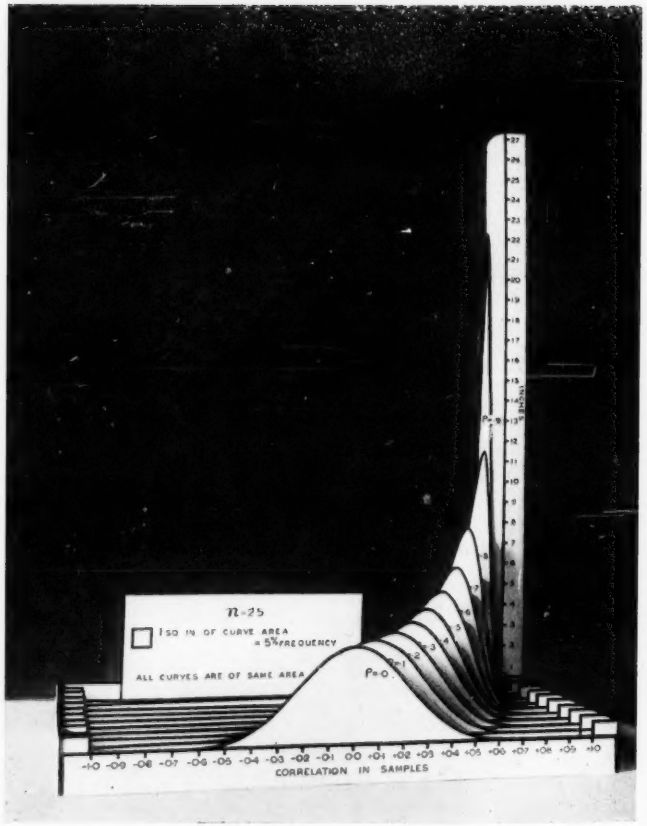

n = 3
1 SQ. IN OF CURVE AREA = 5% FREQUENCY
ALL CURVES ARE OF SAME TOTAL AREA
INCHES
P=0
-1·0 -0·9 -0·8 -0·7 -0·6 -0·5 -0·4 -0·3 -0·2 -0·1 0·0 +0·1 +0·2 +0·3 +0·4 +0·5 +0·6 +0·7 +0·8 +0·9 +1·0
COR. "LATION IN SAMPLES

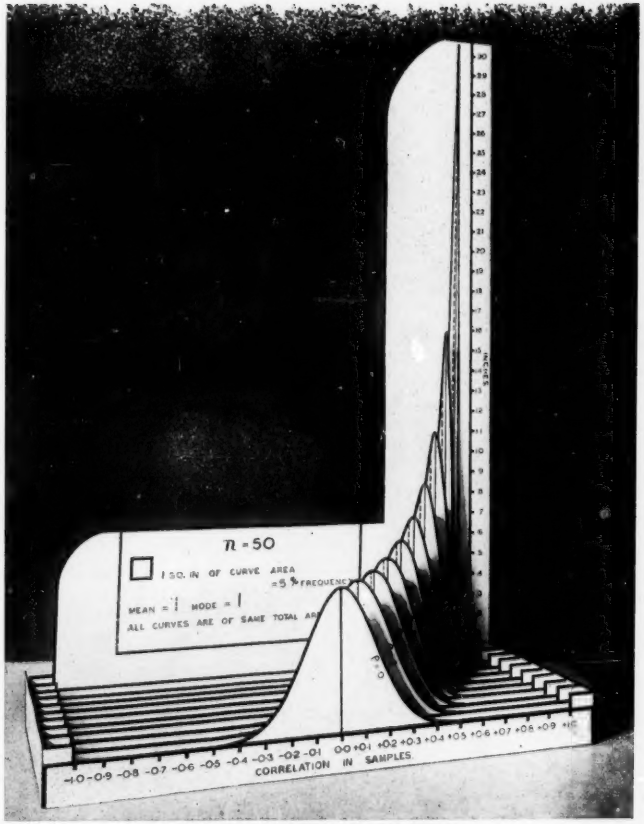

n = 3
1 SQ. IN OF CURVE AREA = 5% FREQUENCY
ALL CURVES ARE OF SAME TOTAL AREA
INCHES
P=0
-1·0 -0·9 -0·8 -0·7 -0·6 -0·5 -0·4 -0·3 -0·2 -0·1 0·0 +0·1 +0·2 +0·3 +0·4 +0·5 +0·6 +0·7 +0·8 +0·9 +1·0
CORRELATION IN SAMPLES

Correlation in Small Samples, $\rho = 0{\cdot}0$ to $\rho = 0{\cdot}9$. Frequency curves for samples of size three. Model C in two aspects, illustrating the various U-forms of curves, which occur in this case

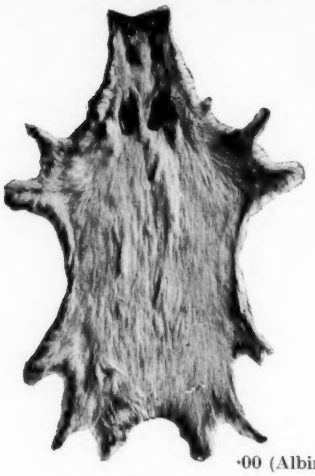


Correlation in Small Samples, $\rho = 0{\cdot}0$ to $\rho = 0{\cdot}9$ for samples of four. Model D, illustrating forms of frequency passing from the rectangle to marked J-forms of curves, which occur in this case

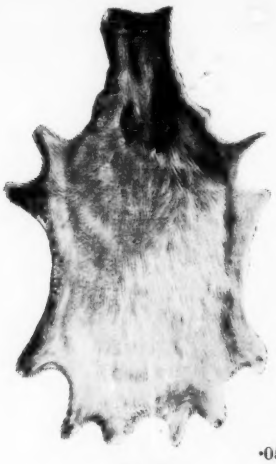




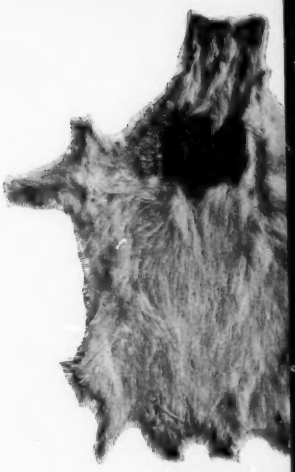
Correlation in Samples of 25 and 50 for $\rho = 0{\cdot}0$ to $\rho = 0{\cdot}9$. Models E and F, illustrating forms still deviating very considerably from normality and increasing in skewness with increase of ρ



·00 (Albino)



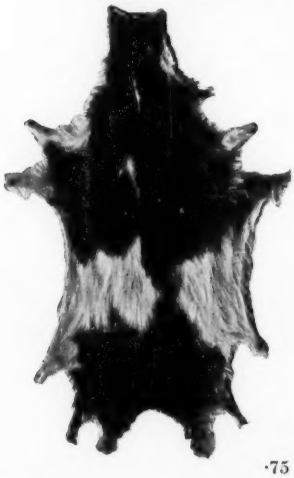
·05



·65

·60

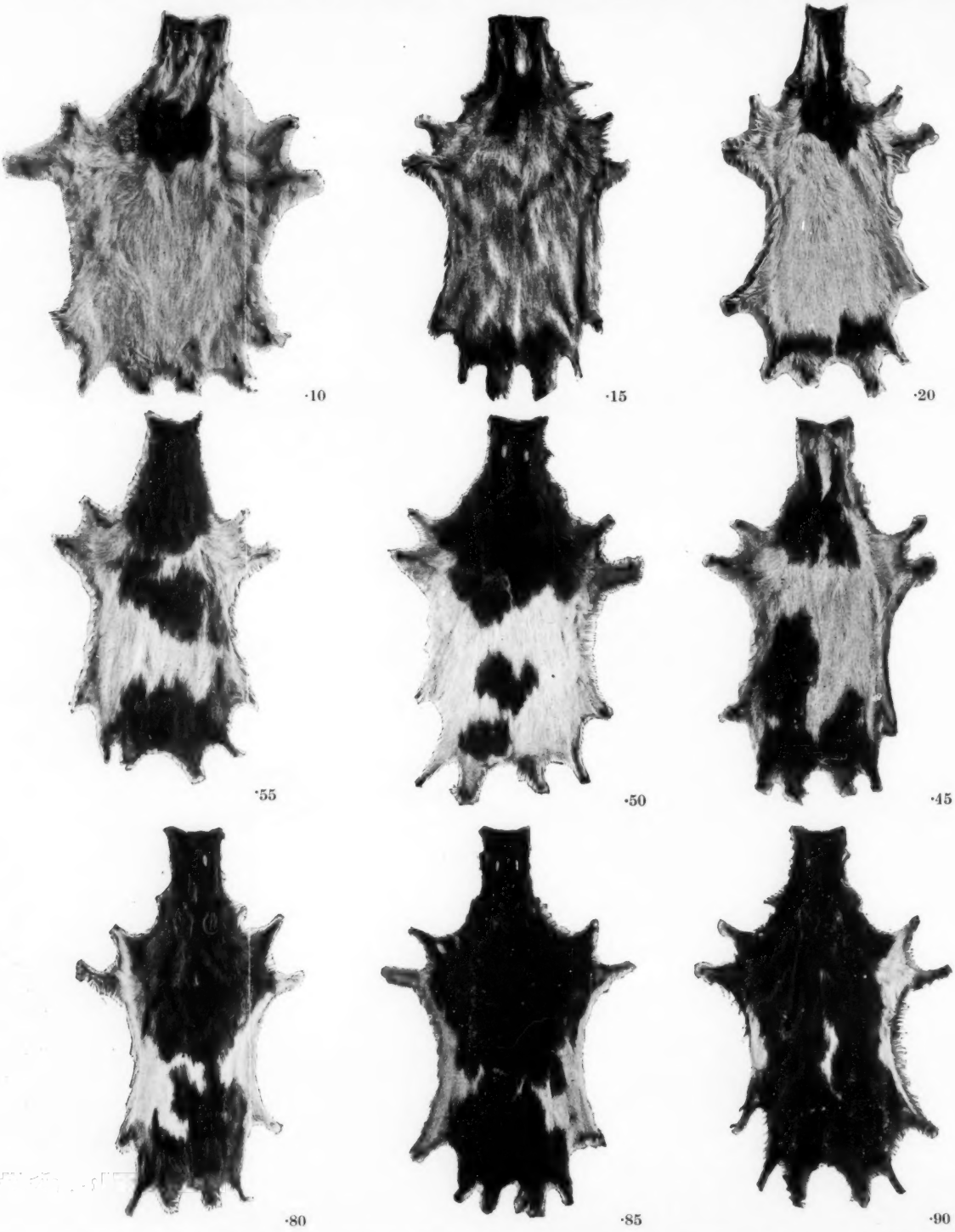
·70



·75

The actual photographs are somewhat deceptive, as shadow or roughness on the actual skin

PHOTOGRAPHS OF MICE SKINS TO ILLUSTRATE AMOUNT OF PIEBALDISM



us shadow or roughness on the actual skin gives here and there a dark appearance which is not due to the presence of pigment. The series, how

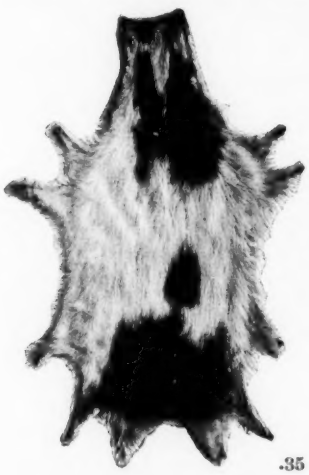
·20

·25

·30

·45

·40



·35

·90

·95

1·00
(Whole
Colour)

The series, however, forms an approximate scale sufficient for practical purposes

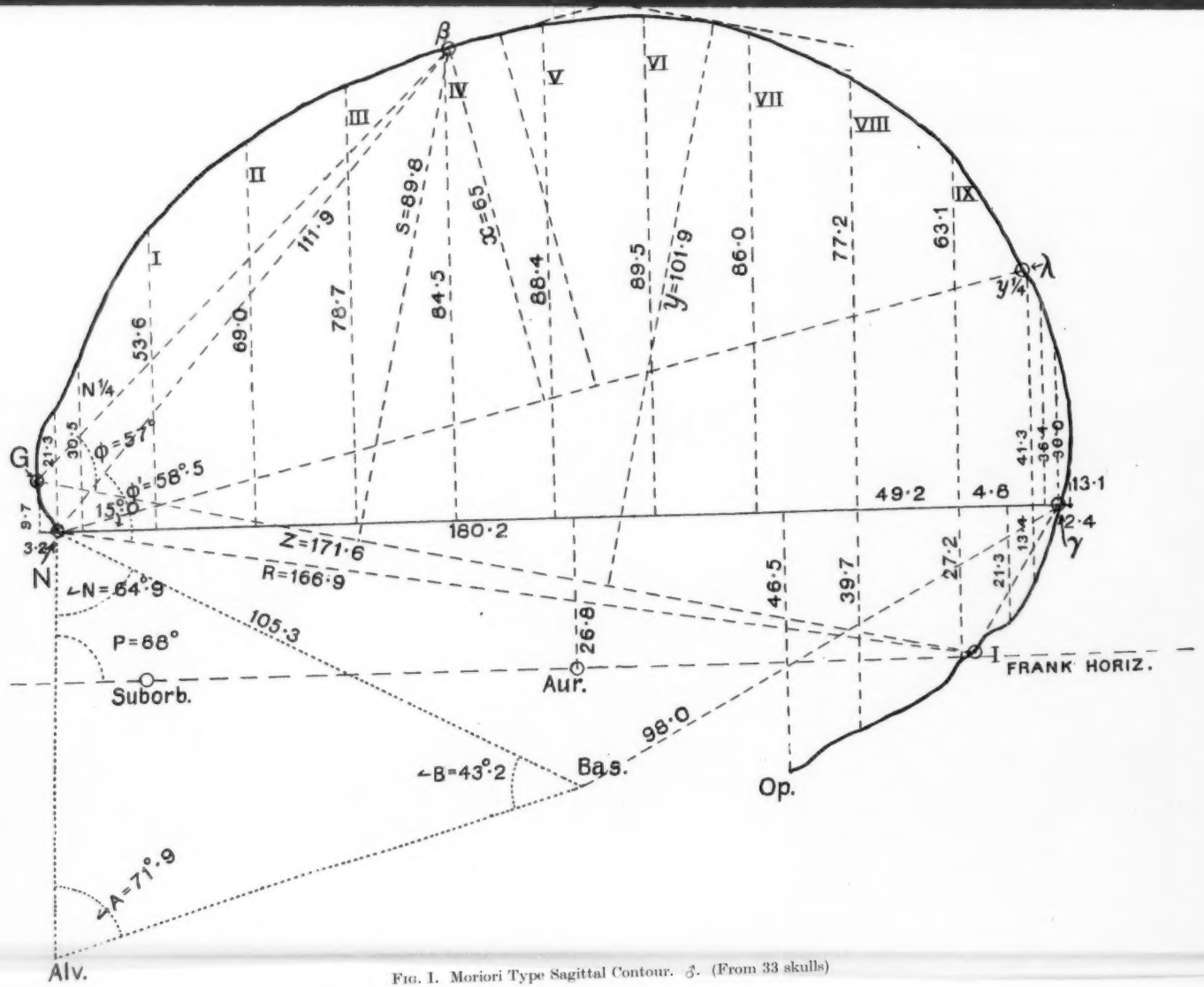


Fig. 1. Moriori Type Sagittal Contour. ♂. (From 33 skulls)

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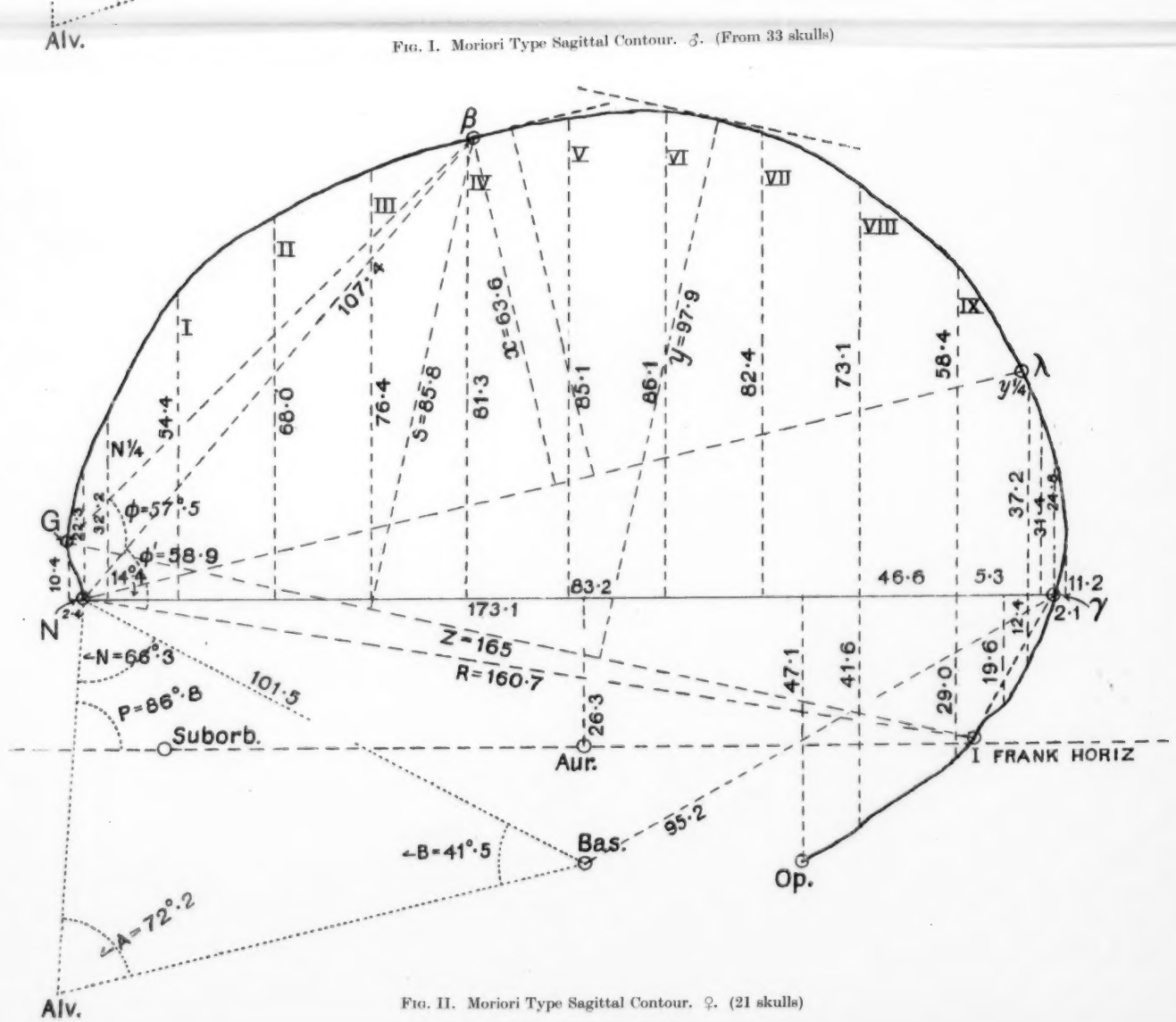


Fig. I. Moriori Type Sagittal Contour. ♂. (From 33 skulls)

Fig. II. Moriori Type Sagittal Contour. ♀. (21 skulls)

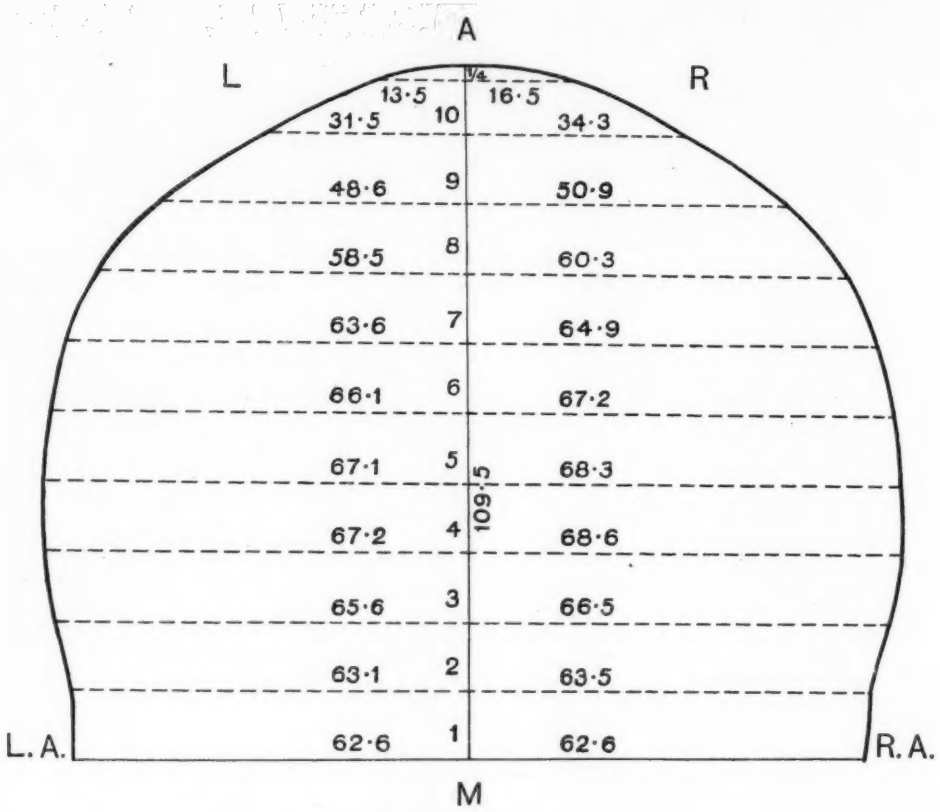


FIG. III. Moriori Type Vertical Contour. ♂. (33 skulls)

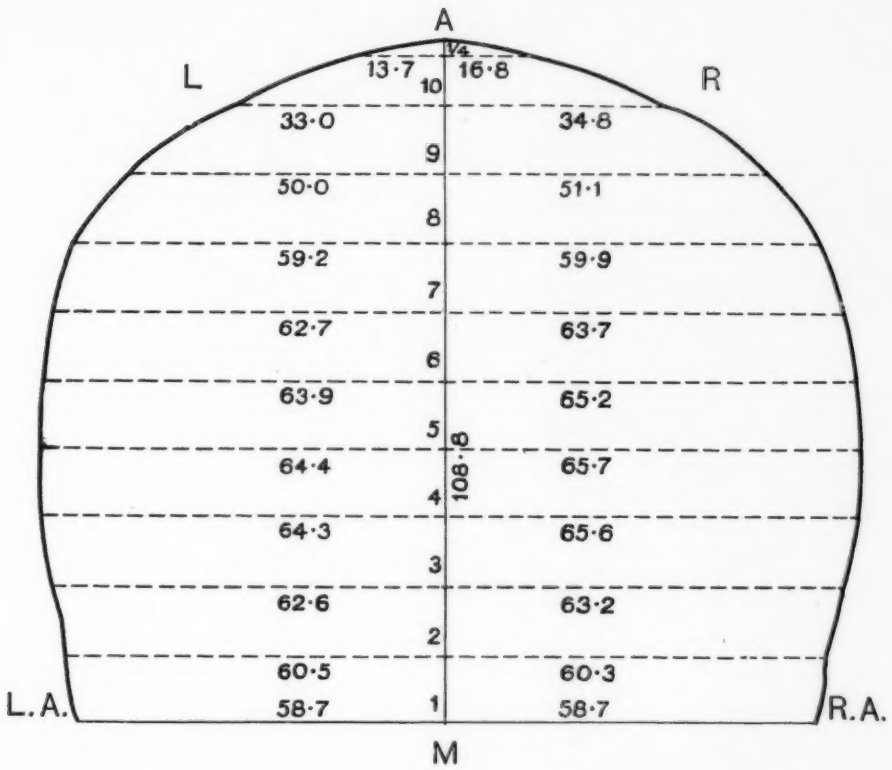


FIG. IV. Moriori Type Vertical Contour. ♀. (21 skulls)

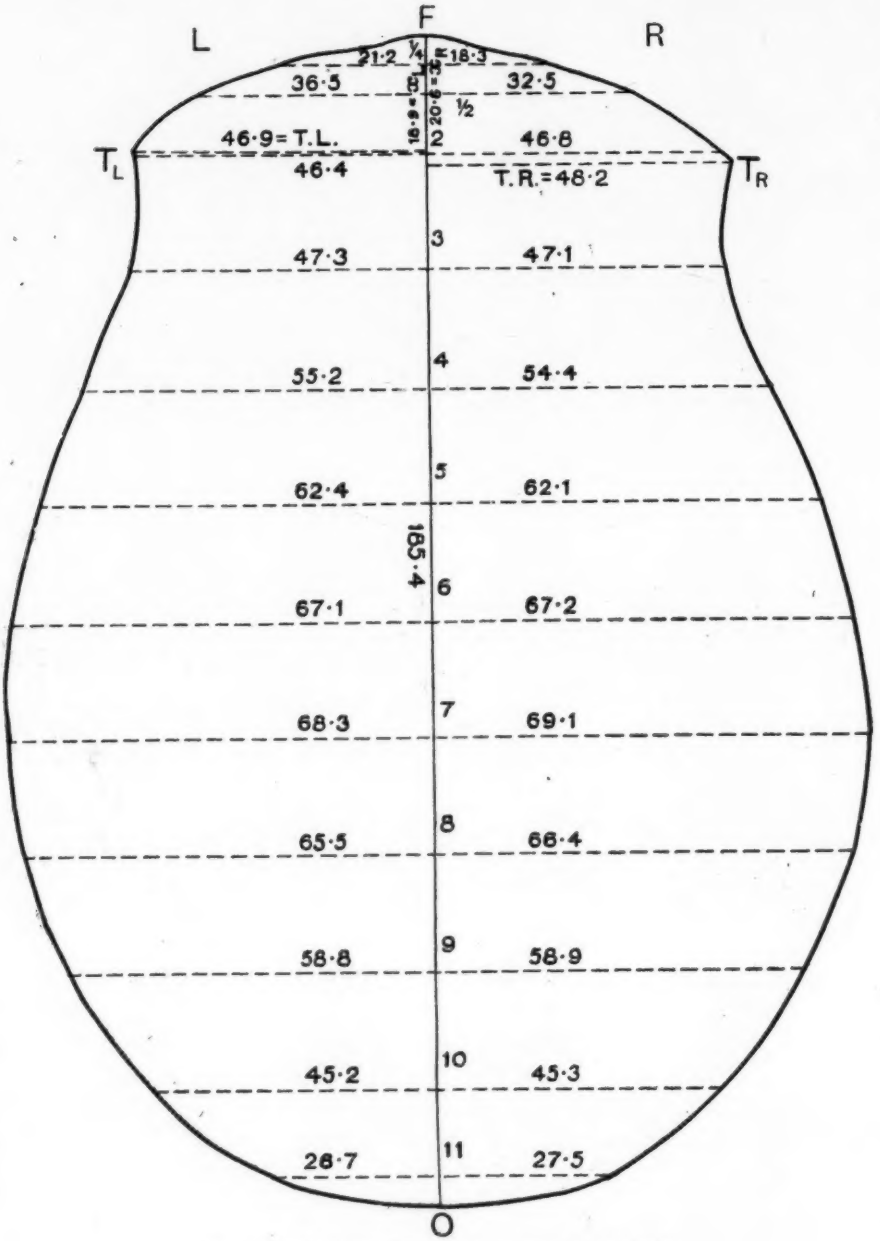


FIG. V. Moriori Type Horizontal Contour. ♂. (33 skulls)

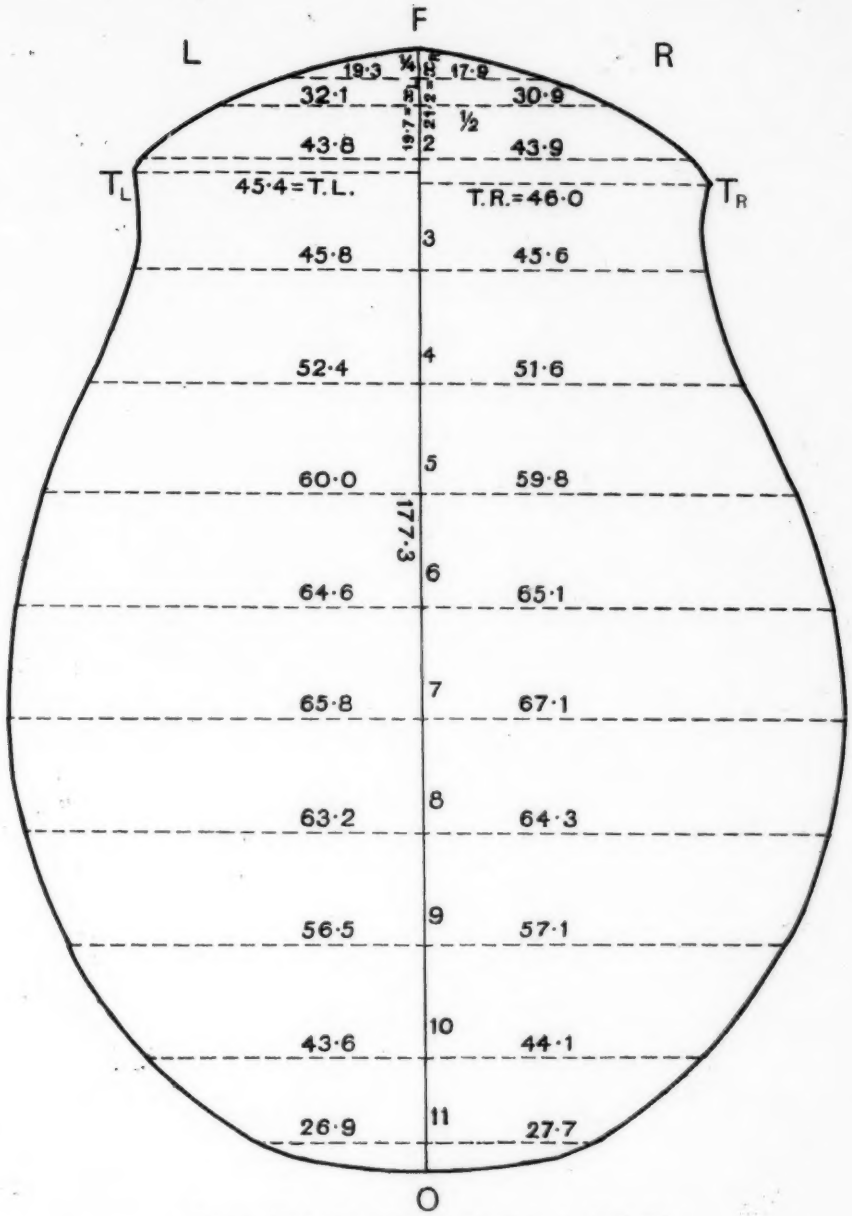
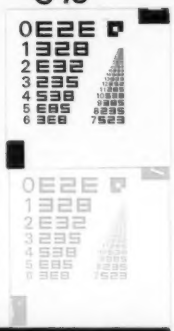


FIG. VI. Moriori Type Horizontal Contour. ♀. (21 skulls)

C15